MAINTENANCE OF THE WATER SUPPLY DISTRIBUTION SYSTEM OF NEW YORK CITY

PRESENTED AT MEETING OF NEW YORK SECTION OF THE AMERICAN WATER WORKS ASSOCIATION, THURSDAY, DECEMBER 3, 1914.

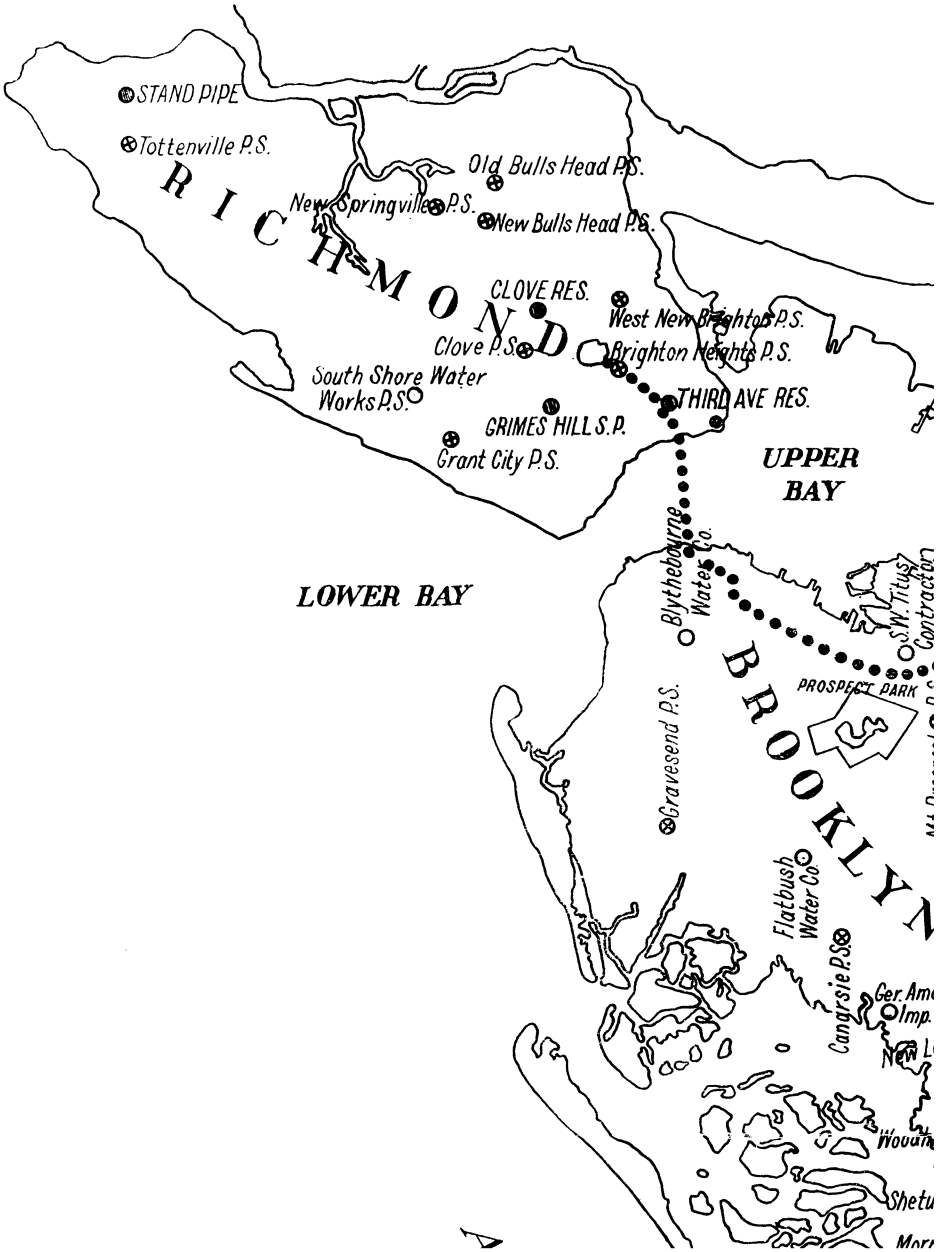
BY WILLIAM W. BRUSH

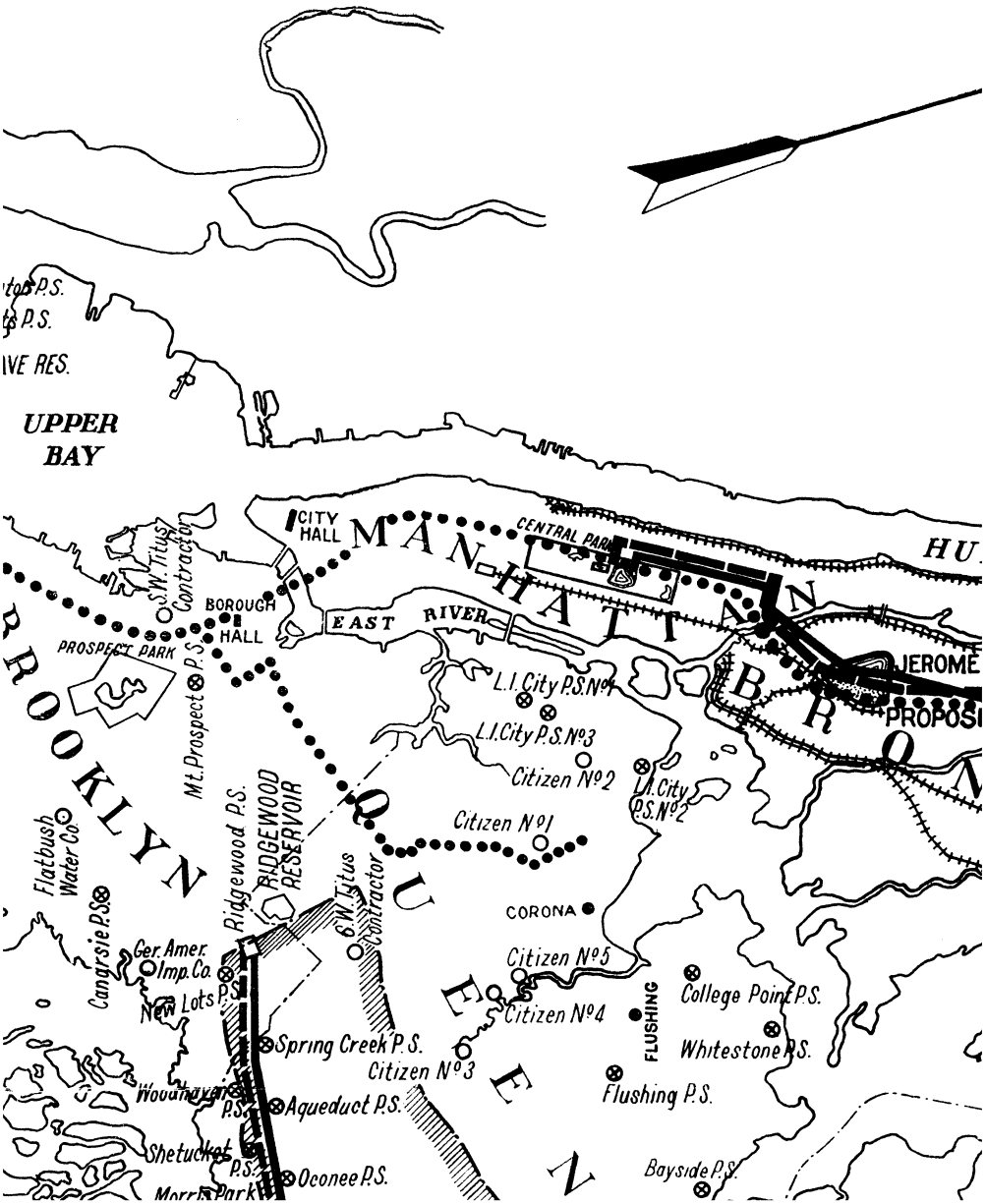
Engineers are prone to give first place to the construction of new works and consider that the maintenance of engineering works does not present problems of equal importance or interest. Such an attitude is unfortunate, and is generally based on a lack of knowledge of the magnitude of maintenance problems and the opportunities in maintenance work for the display of engineering and organizing ability of the highest order.

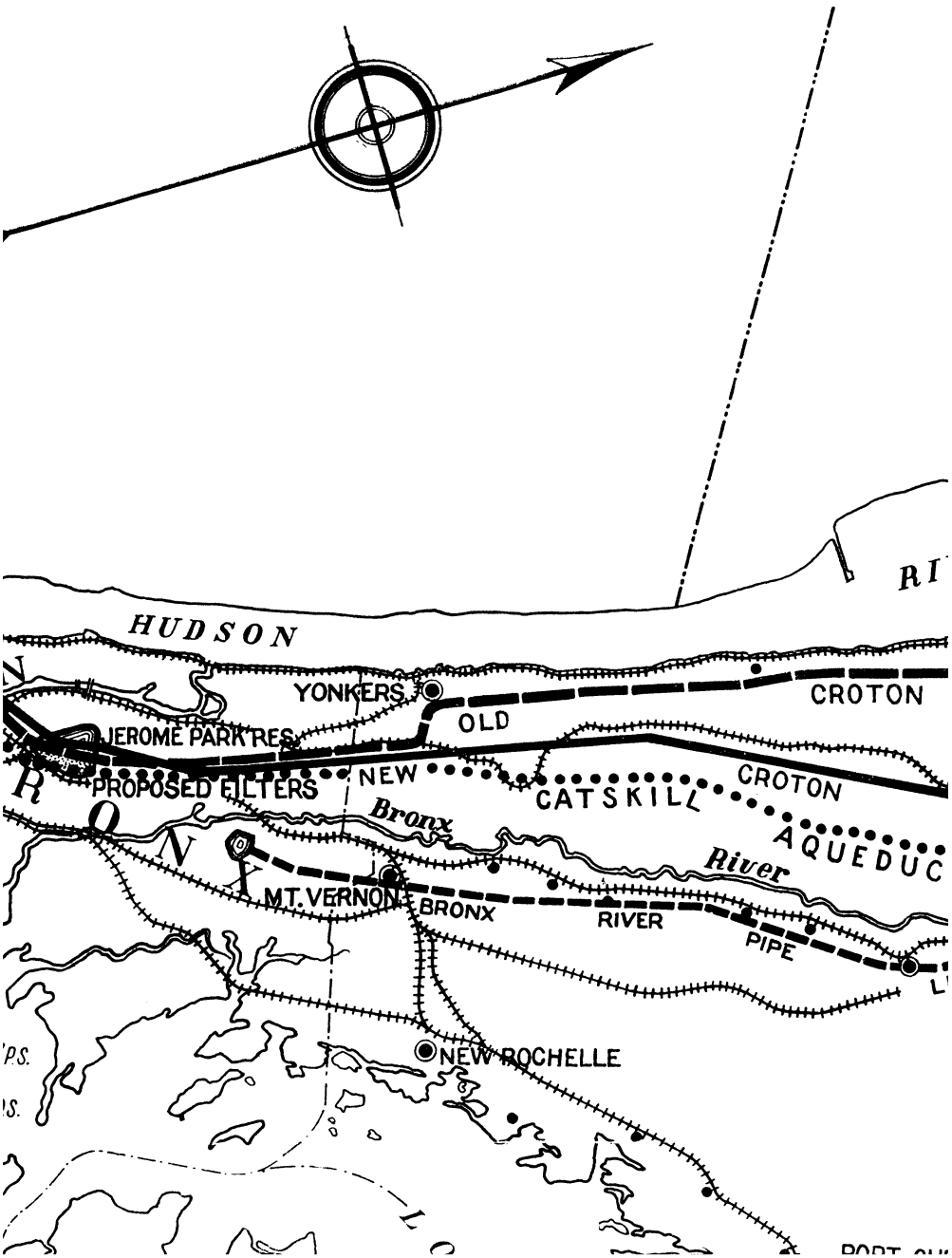
One of the results of the engineer's failure to appreciate the proper position of maintenance work in the engineering field is the relatively few papers published on this subject. The difficulty of obtaining data on organization and methods in use in large maintenance operations is strong testimony to the truth of the above statement. The writer has, therefore, prepared the following description of the maintenance of the distribution system of New York City, believing that more published information on such subjects would be helpful to the profession.

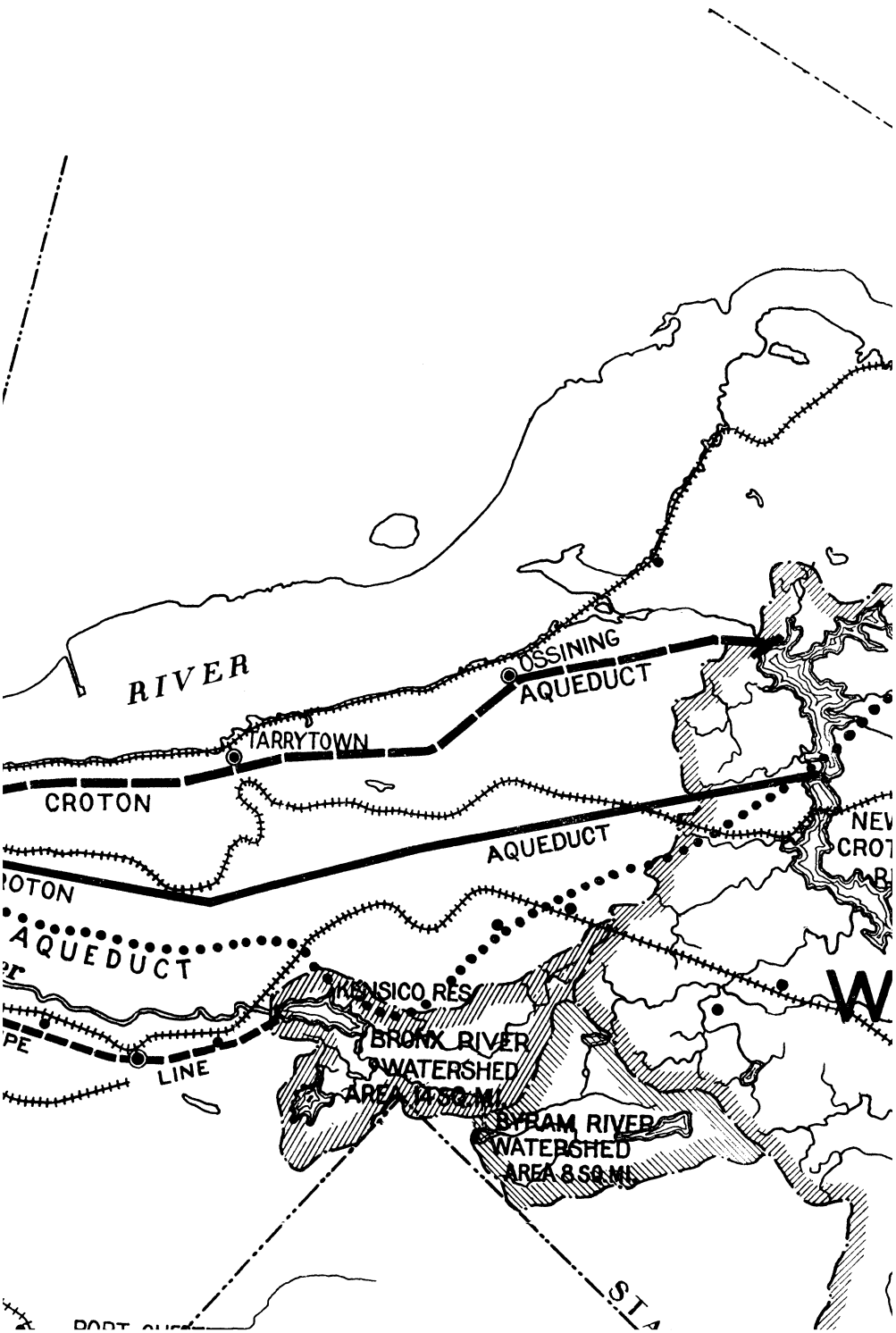
The distribution system of New York covers an area which is 35 miles long and 20 miles broad, and divided by canals, rivers and bays which have to be crossed by the distribution mains. A number of islands having a population varying from a few hundred to several thousand must also be supplied, and add to the complexity of the problem. See Diagram No. 1.

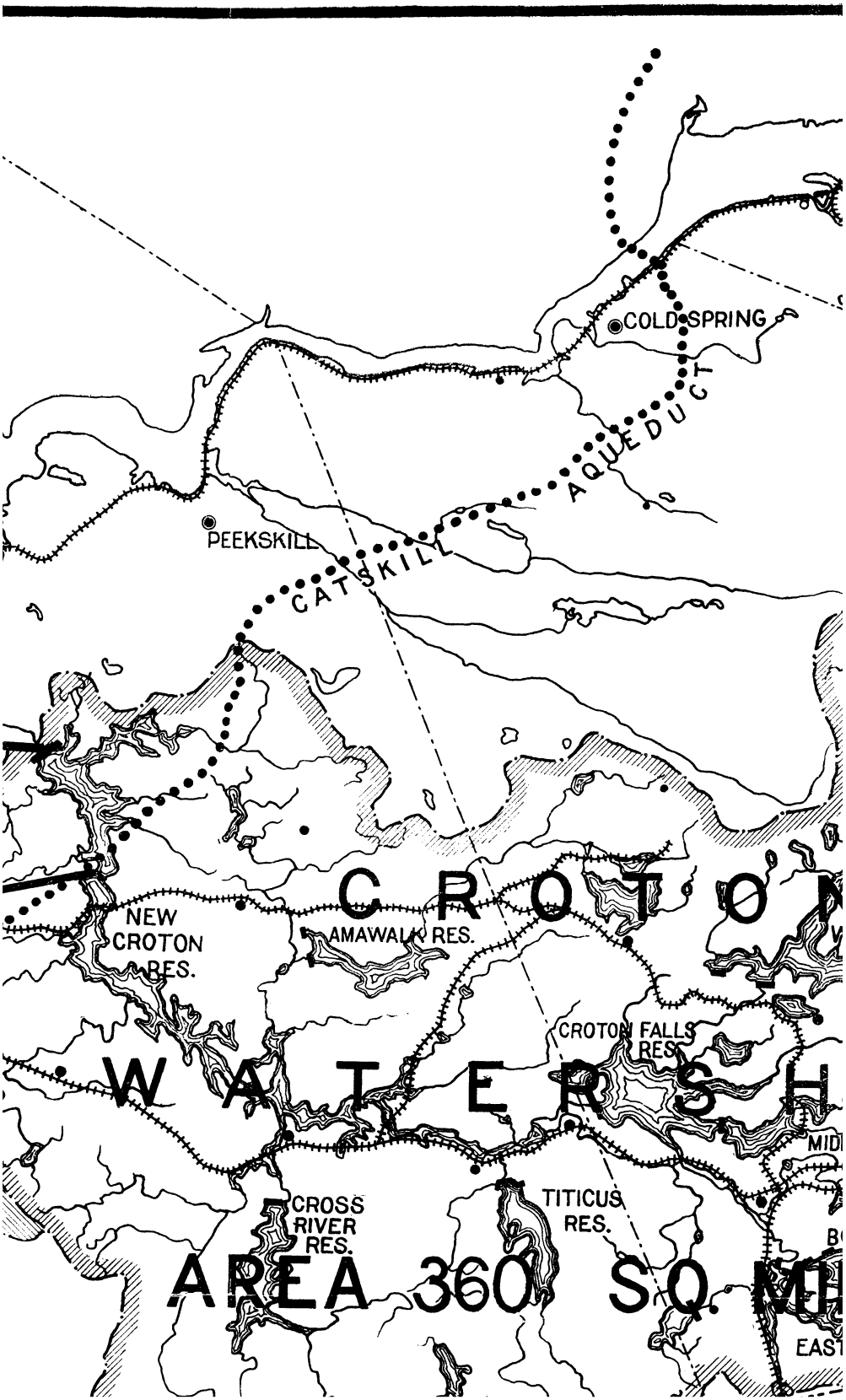
Eight distribution reservoirs of a total capacity of 2500 m.g., with surfaces varying from 119 feet to 250 feet above tide level, and eight stand pipes, with overflows varying from 140 feet to 453 feet above tide level, are used to equalize the flow to the fourteen separate services in the five boroughs. See Table No. 1. Excluding tunnels and masonry conduits, there are 2800 miles of mains of sizes

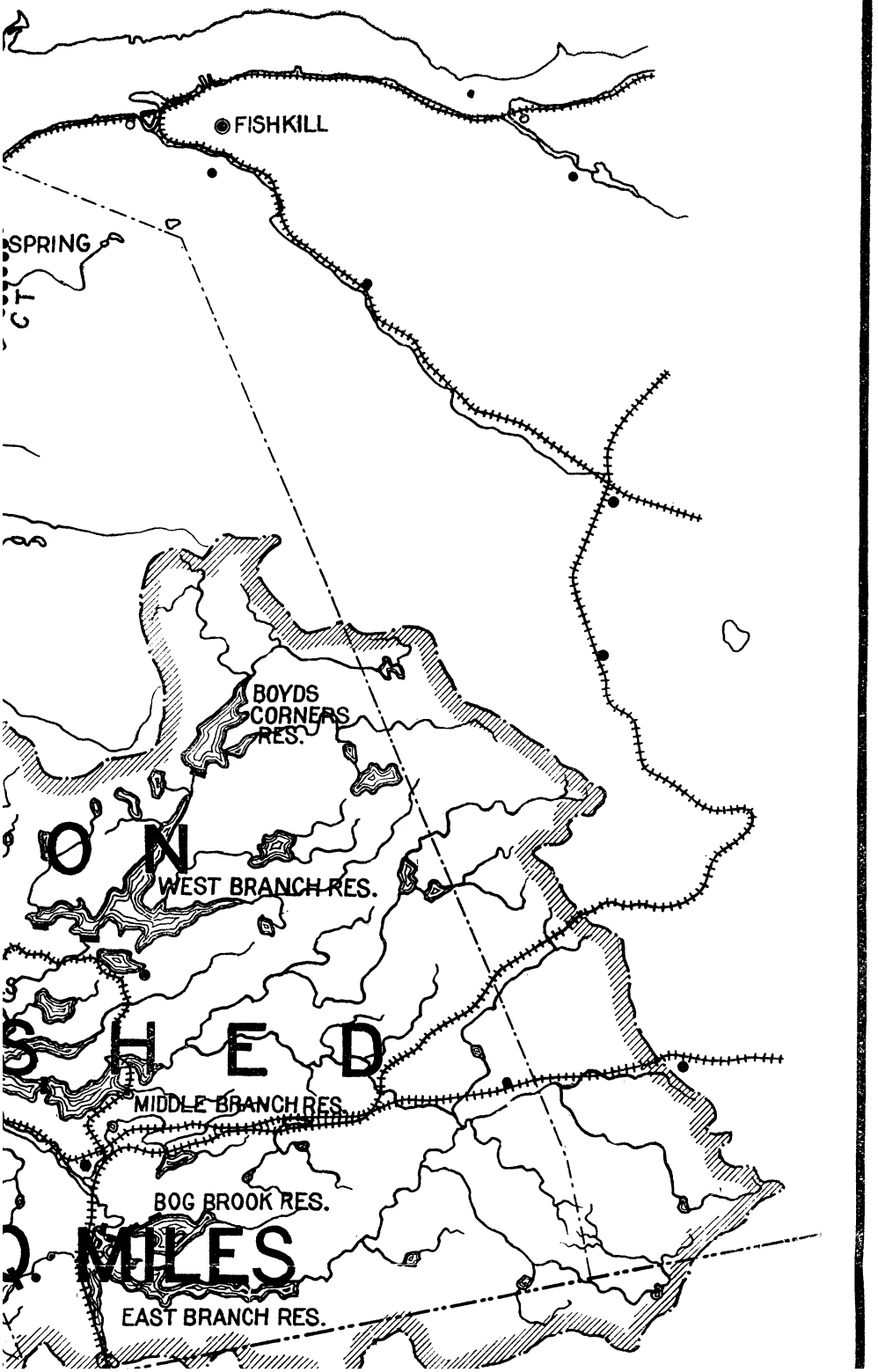

STAND PIPE
Tottenville P.S.
Old Bulls Head P.S.
New Springville P.S.
New Bulls Head P.S.
RICHMOND
CLOVE RES.
West New Brighton P.S.
Clove P.S.
Brighton Heights P.S.
South Shore Water Works P.S.
THIRD AVE RES.
GRIMES HILL S.P.
Grant City P.S.
UPPER BAY
LOWER BAY
Blythebourne Water Co.
S.W. Titus Contractor
PROSPECT PARK
BROOKLYN
Gravesend P.S.
Flatbush Water Co.
Cangrsie P.S.
Ger. Amer. Imp.
New L
Wouar
Shetu
Morr


P.S.
P.S.
IVE RES.
UPPER BAY
CITY HALL
MANHATTAN
CENTRAL PARK
EAST RIVER
BOROUGH HALL
S.W. Titus Contractor
PROSPECT PARK
Mt. Prospect P.S.
BROOKLYN
L.I. City P.S. No 4
L.I. City P.S. No 3
Citizen No 2
L.I. City P.S. No 2
Citizen No 1
RIDGEWOOD RESERVOIR
Ridgewood P.S.
G.W. Titus Contractor
Flatbush Water Co
Cangrsie P.S.
Ger. Amer. Imp. Co.
New Lots P.S.
CORONA
Citizen No 5
Citizen No 4
College Point P.S.
FLUSHING
Whitestone P.S.
Spring Creek P.S.
Citizen No 3
Flushing P.S.
Aqueduct P.S.
Oconee P.S.
Bayside P.S.
QUEENS

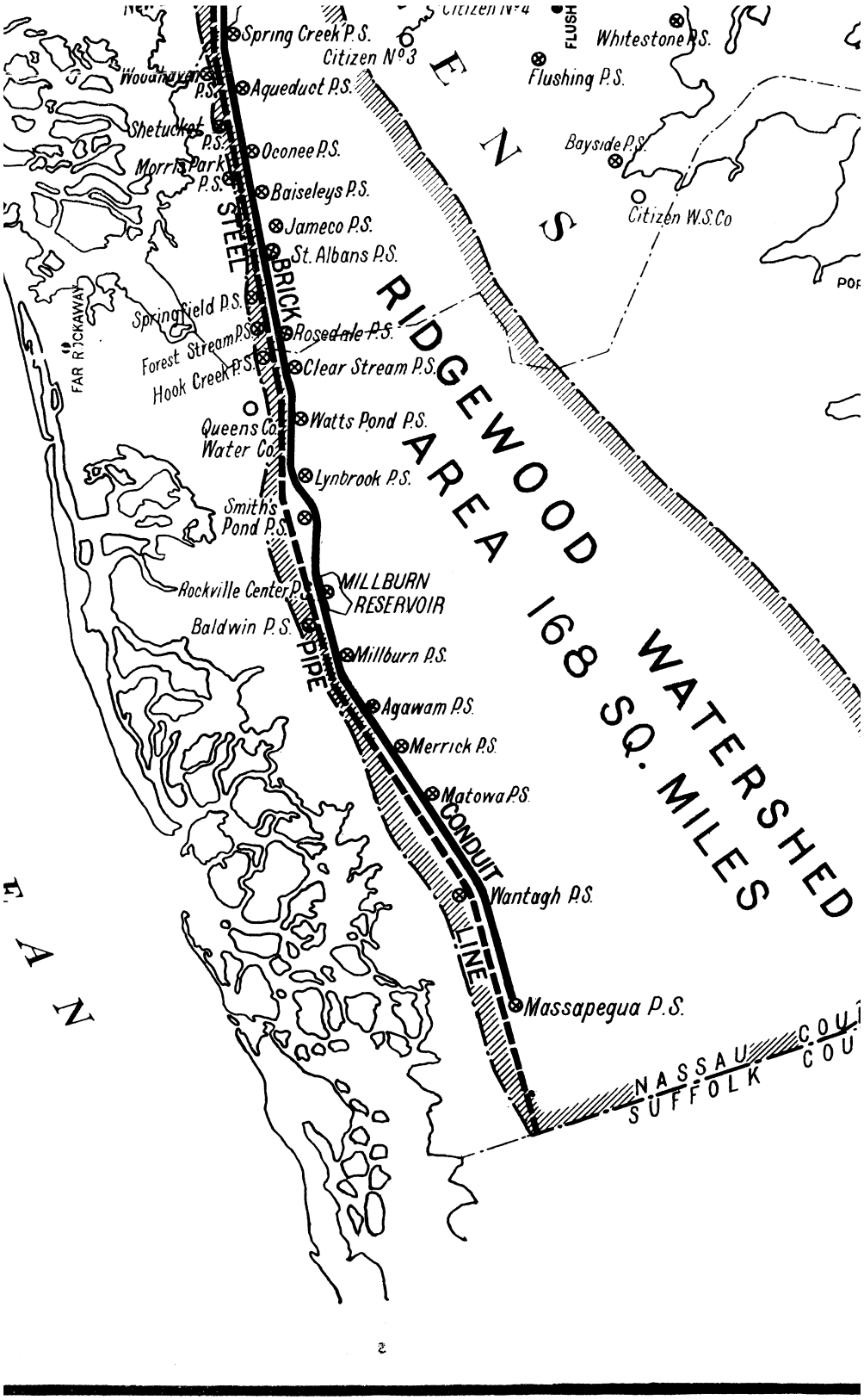

HUDSON
YONKERS
CROTON
OLD
JEROME PARK RES.
NEW
CROTON
PROPOSED FILTERS
CATSKILL
AQUEDUC
Bronx
River
MT. VERNON
BRONX
RIVER
PIPE
NEW ROCHELLE


RIVER
OSSINING
AQUEDUCT
TARRYTOWN
CROTON
AQUEDUCT
AQUEDUCT
KENSICO RES
BRONX RIVER
WATERSHED
AREA 17.5 SQ MI
BYRAM RIVER
WATERSHED
AREA 8.5 SQ MI
LINE


COLD SPRING
AQUEDUCT
PEEKSKILL
CATSKILL
NEW
CROTON
RES.
AMAWALK RES.
CROTON FALLS
RES.
CROSS
RIVER
RES.
TITICUS
RES.
AREA 360 SQ MI


FISHKILL
SPRING
BOYDS CORNERS RES.
WEST BRANCH RES.
MIDDLE BRANCH RES.
BOG BROOK RES.
MILES
EAST BRANCH RES.


ATLANTIC OCEAN
FAR ROCKAWAY
DRAWN BY M.STEINFELS


RIDGEWOOD WATERSHED
AREA 168 SQ. MILES
Spring Creek P.S.
Citizen No 3
Citizen No 4
FLUSH
Whitestone P.S.
Flushing P.S.
Aqueduct P.S.
Woodhaven P.S.
Shetucket P.S.
Oconee P.S.
Morris Park P.S.
Baiseleys P.S.
Bayside P.S.
Citizen W.S.Co
Jameco P.S.
St. Albans P.S.
STEEL
BRICK
Springfield P.S.
Rosedale P.S.
Forest Stream P.S.
Hook Creek P.S.
Clear Stream P.S.
FAR ROCKAWAY
Queens Co. Water Co.
Watts Pond P.S.
Lynbrook P.S.
Smith's Pond P.S.
Rockville Center P.S.
MILLBURN RESERVOIR
Baldwin P.S.
PIPE
Millburn P.S.
Agawam P.S.
Merrick P.S.
Matowa P.S.
CONDUIT
LINE
Wantagh P.S.
Massapegua P.S.
NASSAU
SUFFOLK
COU
COU
E A N
E N S

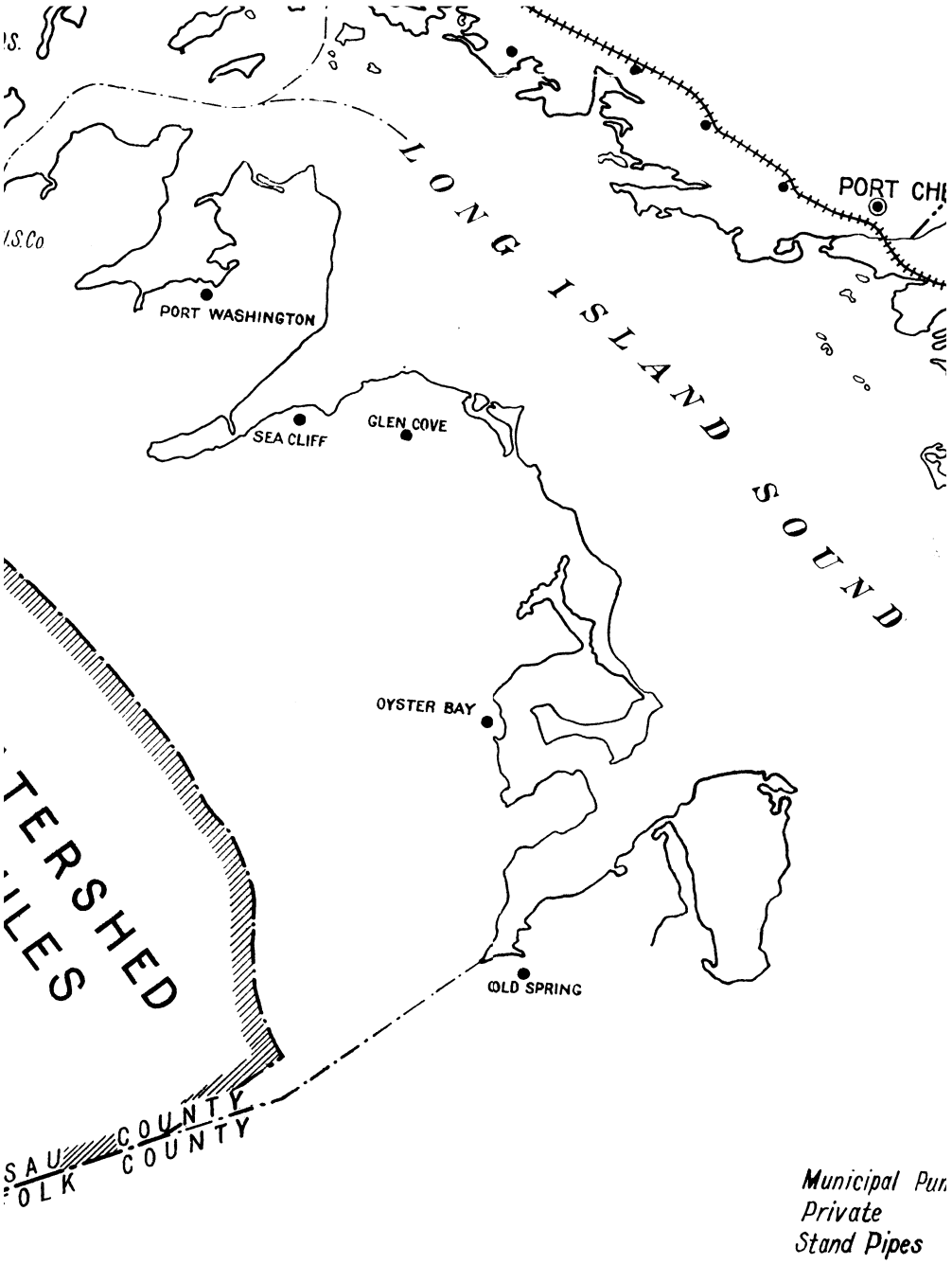
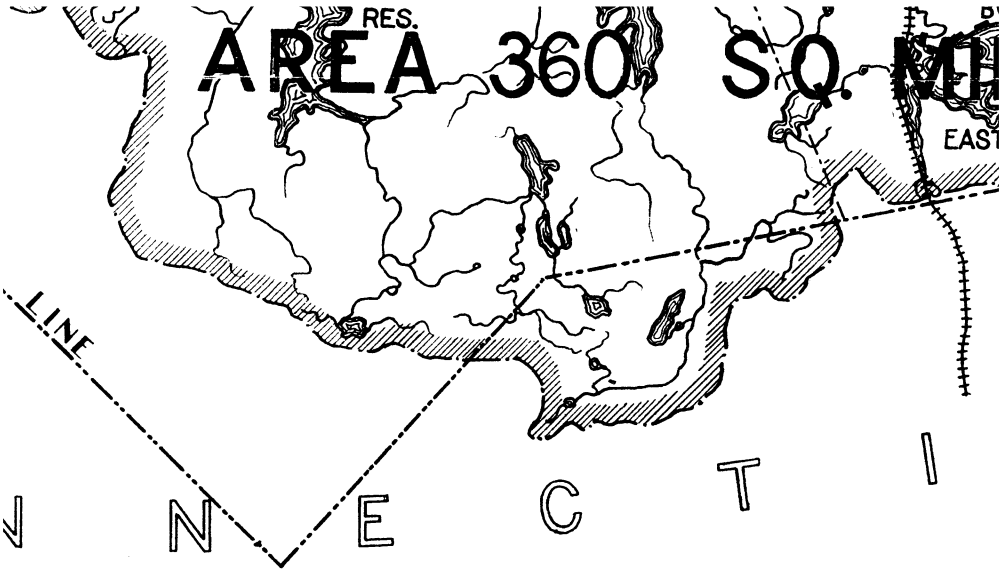

LONG ISLAND SOUND
PORT WASHINGTON
SEA CLIFF
GLEN COVE
OYSTER BAY
OLD SPRING
PORT CH
TERSHED
ILES
NASSAU COUNTY
SUFFOLK COUNTY
Municipal Pur
Private
Stand Pipes

DIAGRAM 1

Municipal Pumping Stations shown thus ⊗
Private " " " " ○
Stand Pipes " " ◍

DIAGRAM 1



CITY OF

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MUNICIPAL AND

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CITY OF NEW YORK

/ATER SUPPLY, GAS & ELECTRICITY

EAU OF WATER SUPPLY

S OF WATER SUPPLY

FOR

PAL AND PRIVATE SYSTEMS

MAY 1912

Scale of Miles

0 1 2 3 4 5

J. M. deBarom

Chief Engineer

varying from 4 inches in diameter up to 60 inches in diameter, to which are connected 60,000 valves, 43,000 hydrants and over 360,000 services. The details are given in Table No. 2. Over 500 m.g.d. are delivered through this system.

The services for each borough are shown on the accompanying diagram, No. 2, which indicates both the area supplied and the

TABLE 1

Watersheds—areas, capacities, drafts, etc.

WATERSHEDS	AREA OF WATERSHED SQ. MI.	SAFE YIELD M.G.	POINT OF DISTRIBUTION	CAPACITY MILLION GALLONS	*ELEV. OF POINT OF DIST.	PRESENT DRAFT FROM WATERSHED M.G.D.
Croton.....	360	336	Jerome Av. Tower	0.039	303	
			Jerome Park Res.	773.000	134	
			High Bridge Tower	0.045	336	329
			High Bridge Res.	11.000	218	
			Central Park Res.	1200.000	119	
Bronx and Byram.....	22	15	Williamsbridge Res.	140.000	197	18
Brooklyn.....	New 97	150	Ridgewood Res.	304.000	172	
	Old 71		Mt. Prospect Res.	19.185	200	134
			Mt. Prospect Tower	0.112	280	
Queens, 3rd Ward.....	Driven well system. Makes watershed limits indefinite.	6	College Pt. Standpipe	0.895	192	
			Flushing Standpipe	0.800	221	15
			Ridgewood Res.†	304.000	172	
Richmond....		9	Tottenville Standpipe	0.140	143	
			Grymes Hill Standpipe	0.220	453	
			Third Ave. Res.	0.800	212	12
			Clove Res.	2.900	254	

* Datum = Mean sea level at Sandy Hook.

† Brooklyn system furnishes about 10 m.g.d. to 1st Ward.

elevation of reservoir or stand pipe controlling the hydraulic gradient. In addition to the domestic system, there are three separate high pressure fire systems covering over 7200 acres with 170 miles of mains from 8 inches to 24 inches in diameter, on which are located 4100 hydrants and 6650 valves.

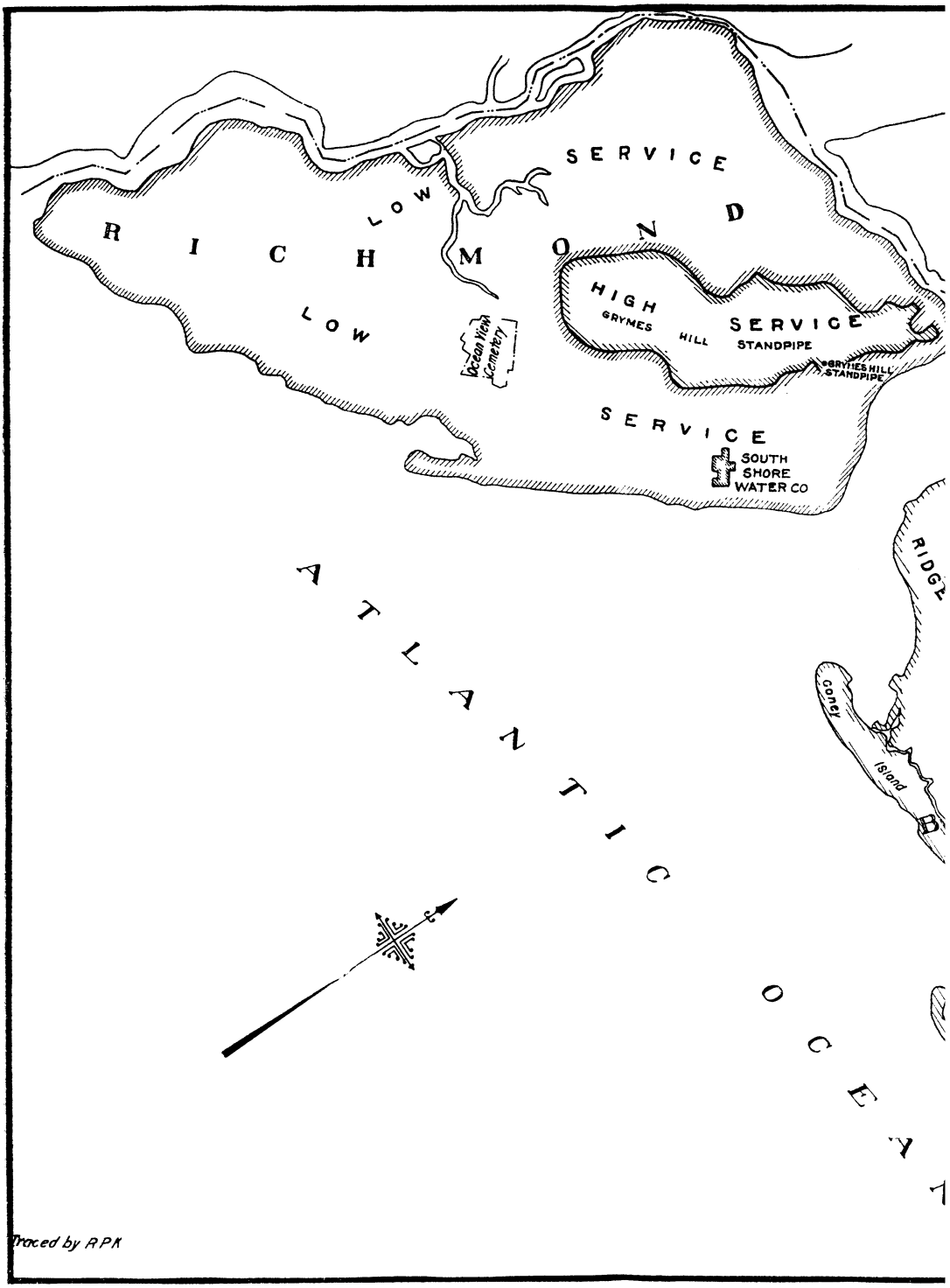
To the existing system there is to be added in about a year the great Catskill system, with its 17 miles of rock tunnel, 22 feeding

TABLE 2

Distribution mains, valves and hydrants in place—1914

	MANHATTAN AND BRONX	BROOKLYN	QUEENS	RICHMOND
inches	*feet*	*feet*	*feet*	*feet*
Mains				
60	800	.....	.....	.....
48	245,000	166,000	.....	.....
36	281,000	61,000	.....	.....
30	54,000	89,000	46,000	16
24	13,000	42,000	42,000	53,000
20	529,000	371,000	38,000	59,000
16	34,000	266,000	35,000	50,000
14	2,000	3,000	7,000	11,000
12	245,000	562,000	250,000	263,000
10	14,000	20,000	32,000	29,000
8	148,000	69,000	440,000	270,000
6	3,345,000	2,122,000	303,000	302,000
4	133,000	137,000	42,000	307,000
Total	5,043,800	3,908,000	1,235,000	1,344,016
Valves				
48	65	24	.....	.....
36	111	69	.....	.....
30	45	82	9	.....
24	21	77	11	.....
20	555	702	62	80
16	31	656	28	50
14		1	9	21
12	6,763	1,629	703	304
10	10	7	45	41
8	551	4,813	1,233	917
6	19,936	14,044	2,020	2,262
4	375	134	34	1,031
Total	28,463	22,238	4,154	4,706
Hydrants				
Total (all patterns)	20,125	17,782	2,798	2,593

shafts, and 16 miles of delivery mains, varying on land from 48 inches to 66 inches in diameter, and including two miles of 36 inch submerged pipe, connecting Brooklyn with Richmond.


SERVICE
LOW
RICHMOND
HIGH
SERVICE
GRYMES HILL
STANDPIPE
LOW
Ocean View Cemetery
GRYMES HILL STANDPIPE
SERVICE
SOUTH SHORE WATER CO
RIDGE
ATLANTIC OCEAN
Coney Island
Traced by A.P.K.

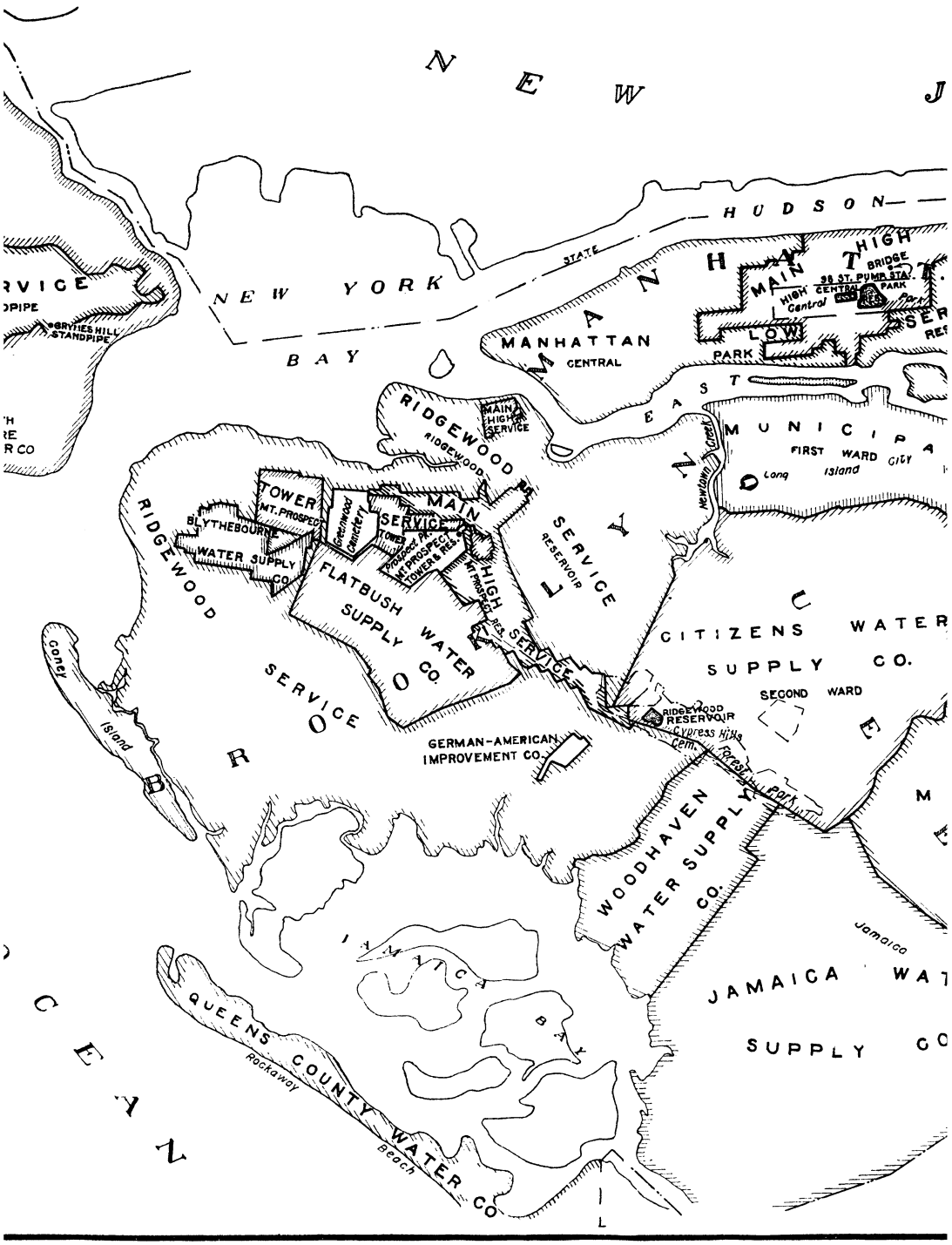
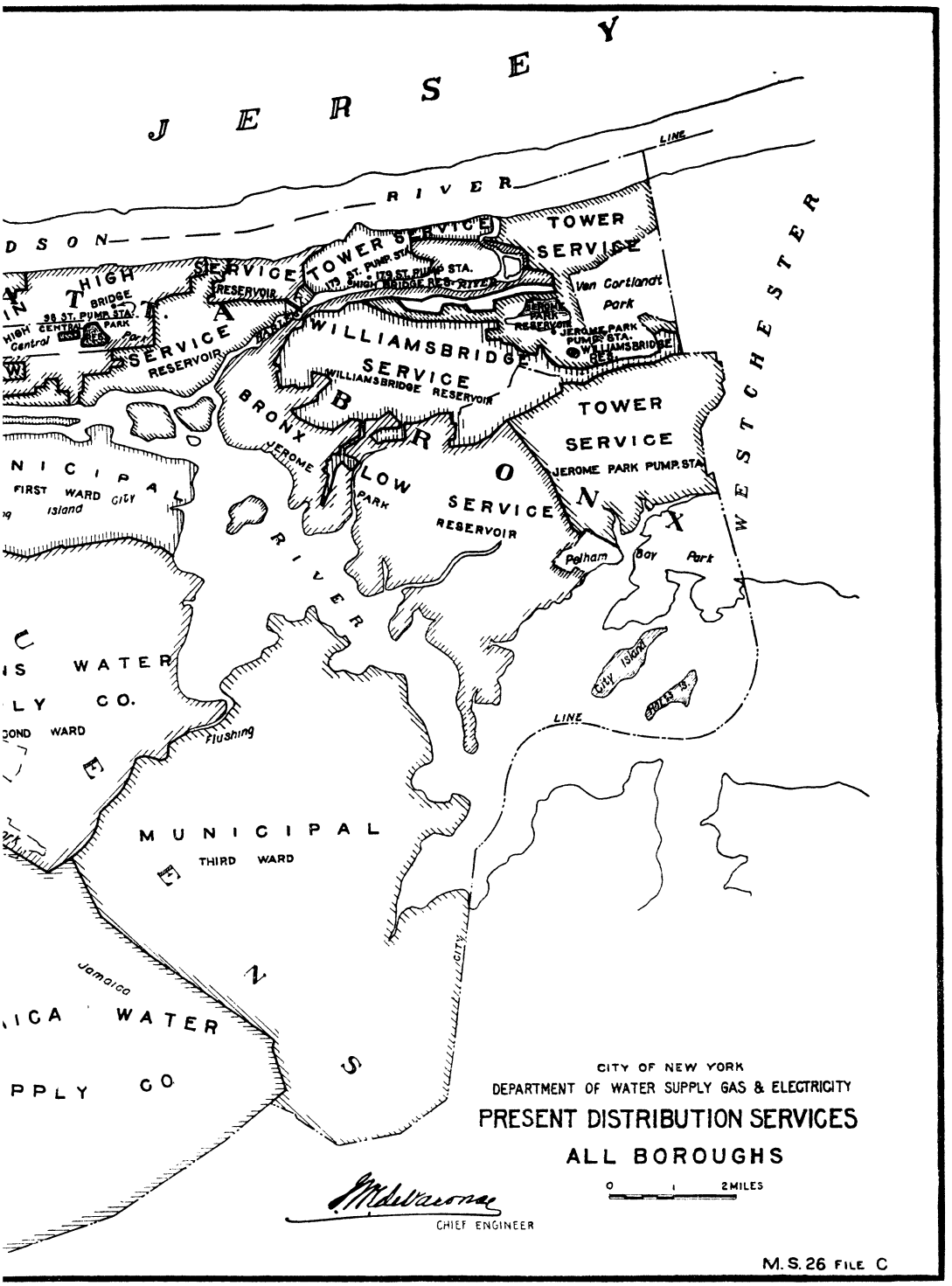
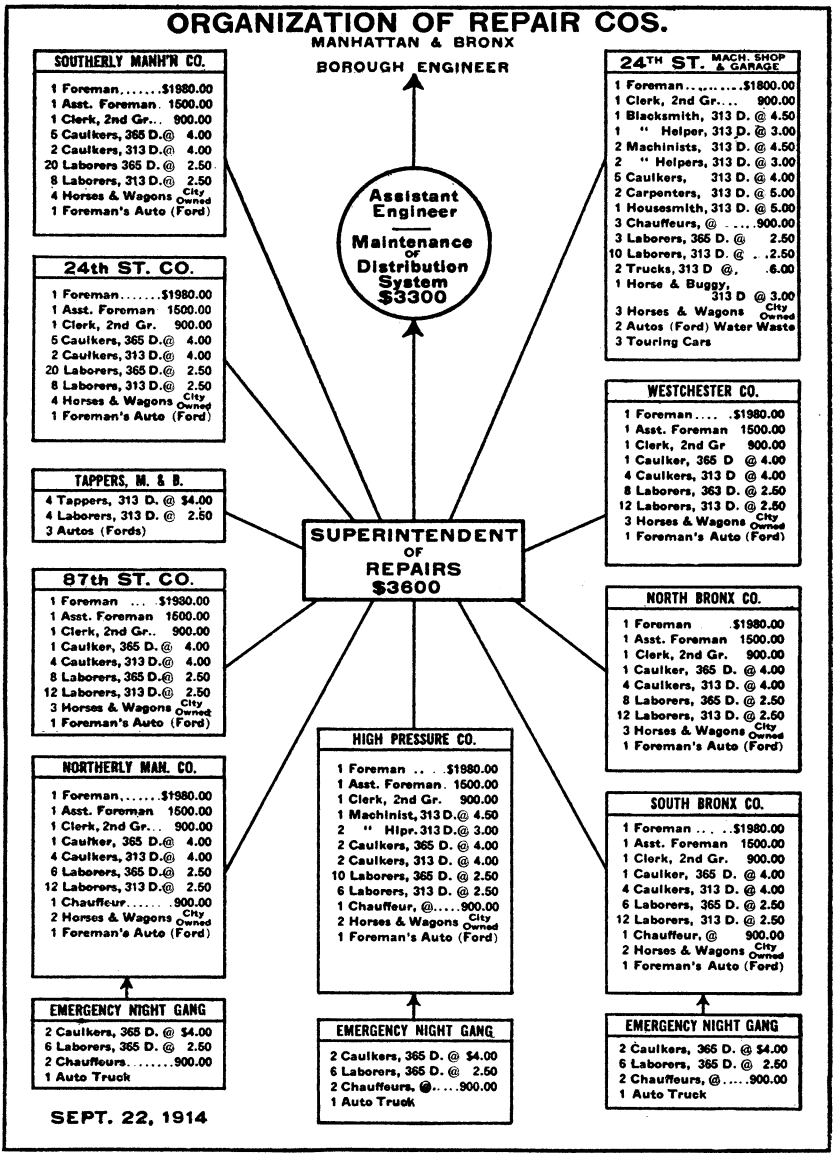

NEW YORK BAY
HUDSON
MANHATTAN
CENTRAL
MAIN HIGH
LOW
PARK
EAST
RIDGEWOOD
MAIN HIGH SERVICE
RIDGEWOOD RESERVOIR
TOWER
MT. PROSPECT
BLYTHEBOURNE
WATER SUPPLY CO.
FLATBUSH SUPPLY WATER CO.
SERVICE RESERVOIR
CITIZENS WATER SUPPLY CO.
SECOND WARD
GERMAN-AMERICAN IMPROVEMENT CO.
WOODHAVEN WATER SUPPLY CO.
JAMAICA WATER SUPPLY CO.
QUEENS COUNTY WATER CO.
Coney Island
Rockaway Beach
JAMAICA BAY
Cypress Hills Cem.
Forest Park
Jamaica
Long Island City
Newtown Creek
FIRST WARD
SECOND WARD
98 ST. PUMP STA.
BRIDGE PARK
GRYTIES HILL STANDPIPE

DIAGRAM 2


JERSEY
LINE
RIVER
TOWER SERVICE
SERVICE RESERVOIR
TOWER SERVICE
179 ST. PUMP STA.
HIGH BRIDGE
HIGH BRIDGE RES.
RIVER
Van Cortlandt Park
WILLIAMSBRIDGE RESERVOIR
JEROME PARK PUMP STA.
WILLIAMSBRIDGE RES.
WILLIAMSBRIDGE SERVICE
WILLIAMSBRIDGE RESERVOIR
BRONX
JEROME PARK
TOWER SERVICE
JEROME PARK PUMP STA.
WESTCHESTER
FIRST WARD
CITY Island
BRONX
LOW PARK
SERVICE RESERVOIR
Pelham Bay Park
RIVER
City Island
HOG I.
LINE
WATER CO.
FLUSHING
MUNICIPAL
THIRD WARD
Jamaica
WATER
CO.
CITY OF NEW YORK
DEPARTMENT OF WATER SUPPLY GAS & ELECTRICITY
PRESENT DISTRIBUTION SERVICES
ALL BOROUGHS
0 1 2 MILES
CHIEF ENGINEER
M.S. 26 FILE C


ORGANIZATION OF REPAIR COS.
MANHATTAN & BRONX
BOROUGH ENGINEER
Assistant Engineer
Maintenance OF Distribution System $3300
SUPERINTENDENT OF REPAIRS $3600
SOUTHERLY MANH'N CO.
1 Foreman.....$1980.00
1 Asst. Foreman 1500.00
1 Clerk, 2nd Gr... 900.00
5 Caulkers, 365 D.@ 4.00
2 Caulkers, 313 D.@ 4.00
20 Laborers 365 D. @ 2.50
8 Laborers, 313 D.@ 2.50
4 Horses & Wagons City Owned
1 Foreman's Auto (Ford)
24th ST. CO.
1 Foreman.....$1980.00
1 Asst. Foreman 1500.00
1 Clerk, 2nd Gr. 900.00
5 Caulkers, 365 D.@ 4.00
2 Caulkers, 313 D.@ 4.00
20 Laborers, 365 D.@ 2.50
8 Laborers, 313 D.@ 2.50
4 Horses & Wagons City Owned
1 Foreman's Auto (Ford)
TAPPERS, M. & B.
4 Tappers, 313 D. @ $4.00
4 Laborers, 313 D. @ 2.50
3 Autos (Fords)
87th ST. CO.
1 Foreman ... $1930.00
1 Asst. Foreman 1500.00
1 Clerk, 2nd Gr.. 900.00
1 Caulker, 365 D.@ 4.00
4 Caulkers, 313 D.@ 4.00
8 Laborers, 365 D.@ 2.50
12 Laborers, 313 D.@ 2.50
3 Horses & Wagons City Owned
1 Foreman's Auto (Ford)
NORTHERLY MAN. CO.
1 Foreman.....$1980.00
1 Asst. Foreman 1500.00
1 Clerk, 2nd Gr... 900.00
1 Caulker, 365 D.@ 4.00
4 Caulkers, 313 D.@ 4.00
6 Laborers, 365 D.@ 2.50
12 Laborers, 313 D.@ 2.50
1 Chauffeur..... 900.00
2 Horses & Wagons City Owned
1 Foreman's Auto (Ford)
EMERGENCY NIGHT GANG
2 Caulkers, 365 D. @ $4.00
6 Laborers, 365 D. @ 2.50
2 Chauffeurs.....900.00
1 Auto Truck
SEPT. 22, 1914
24TH ST. MACH. SHOP & GARAGE
1 Foreman.....$1800.00
1 Clerk, 2nd Gr.... 900.00
1 Blacksmith, 313 D. @ 4.50
1 " Helper, 313 D. @ 3.00
2 Machinists, 313 D. @ 4.50
2 " Helpers, 313 D. @ 3.00
5 Caulkers, 313 D. @ 4.00
2 Carpenters, 313 D. @ 5.00
1 Housesmith, 313 D. @ 5.00
3 Chauffeurs, @ 900.00
3 Laborers, 365 D. @ 2.50
10 Laborers, 313 D. @ .2.50
2 Trucks, 313 D @, .6.00
1 Horse & Buggy, 313 D @ 3.00
3 Horses & Wagons City Owned
2 Autos (Ford) Water Waste
3 Touring Cars
WESTCHESTER CO.
1 Foreman.... .$1980.00
1 Asst. Foreman 1500.00
1 Clerk, 2nd Gr 900.00
1 Caulker, 365 D @ 4.00
4 Caulkers, 313 D @ 4.00
8 Laborers, 363 D. @ 2.50
12 Laborers, 313 D. @ 2.50
3 Horses & Wagons City Owned
1 Foreman's Auto (Ford)
NORTH BRONX CO.
1 Foreman $1980.00
1 Asst. Foreman 1500.00
1 Clerk, 2nd Gr. 900.00
1 Caulker, 365 D. @ 4.00
4 Caulkers, 313 D. @ 4.00
8 Laborers, 365 D. @ 2.50
12 Laborers, 313 D. @ 2.50
3 Horses & Wagons City Owned
1 Foreman's Auto (Ford)
SOUTH BRONX CO.
1 Foreman $1980.00
1 Asst. Foreman 1500.00
1 Clerk, 2nd Gr. 900.00
1 Caulker, 365 D. @ 4.00
4 Caulkers, 313 D. @ 4.00
6 Laborers, 365 D. @ 2.50
12 Laborers, 313 D. @ 2.50
1 Chauffeur, @ 900.00
2 Horses & Wagons City Owned
1 Foreman's Auto (Ford)
EMERGENCY NIGHT GANG
2 Caulkers, 365 D. @ $4.00
6 Laborers, 365 D. @ 2.50
2 Chauffeurs, @.....900.00
1 Auto Truck
HIGH PRESSURE CO.
1 Foreman $1980.00
1 Asst. Foreman 1500.00
1 Clerk, 2nd Gr. 900.00
1 Machinist, 313 D.@ 4.50
2 " Hlpr. 313 D.@ 3.00
2 Caulkers, 365 D. @ 4.00
2 Caulkers, 313 D. @ 4.00
10 Laborers, 365 D. @ 2.50
6 Laborers, 313 D. @ 2.50
1 Chauffeur, @.....900.00
2 Horses & Wagons City Owned
1 Foreman's Auto (Ford)
EMERGENCY NIGHT GANG
2 Caulkers, 365 D. @ $4.00
6 Laborers, 365 D. @ 2.50
2 Chauffeurs, @....900.00
1 Auto Truck

The maintenance of this system involves an organization and equipment of sufficient size and capacity to promptly respond and shut off the flow of water in case of accident, to promptly repair a broken main, of whatever size it may be, to repair or replace defective hydrants and valves, to cut in new hydrants and valves, to make new connections, to tap the mains for new services, to test service boundaries, to measure flow in trunk and lateral mains, to locate mains and services, to locate and repair leaks on mains, to test meters, to record pressures in system, to control pressures by operation of head gates at reservoirs, to respond to fire alarms, to investigate causes of lack of pressure, to locate and stop leaks and waste in premises, etc.

The organization to handle this work is controlled by the chief engineer, and is directed by four borough engineers, one for each borough, except The Bronx, which is consolidated with Manhattan, the sources of supply being mainly the same for these two boroughs. Under each borough engineer there is an assistant engineer in charge of distribution, with his assistants, foremen, assistant foremen, caulkers, laborers, etc., as shown on Diagram No. 3.

In Manhattan and The Bronx a superintendent is in direct charge of all the repair companies, while in Brooklyn a general foreman has charge of these companies.

The meter shops and the machine shops have their separate forces.

In Brooklyn an assistant engineer with one field party handles all measurements of flow in mains, while for the other boroughs, an assistant engineer with two field parties is assigned to this work. Separate labor gangs operate gates, place taps for measurement of flow, locate leaks, etc., under the direct control of the measurement of flow parties.

To promptly and economically handle the field maintenance work connected with the distribution system it is necessary to divide the territory covered by said system. As borough lines are generally recognized as lines of division for New York City activities, these have been used as the boundaries of the major divisions of territory. Each borough has been divided into districts, with a repair company under the direction of a foreman assigned to such district. Separate provision has been made for the high pressure fire service system. The repair companies in the various boroughs are as follows:

Manhattan. Four low pressure companies and one high pressure repair company.

Brooklyn. Four companies, the high pressure system being handled by an assistant foreman and gang under the foreman of a repair company.

Bronx. Three companies.

Queens. Two companies.

Richmond. Three companies.

The force and rates of pay for employes have already been given for each company. Table No. 3 gives the number of men, annual payroll, area covered, miles of mains and number of valves and hydrants for each company. The more important items of work done by these repair companies are given for each borough.

REPAIR COMPANY ORGANIZATION

The gang organization has a caulker as the head, with from three to six laborers as assistants, depending upon the nature of the work. To each such gang is assigned a horse and wagon that transport the gang to and from the work, and deliver material and tools required. Where a larger force is required, two or more gangs are consolidated, working under the direction of one of the caulkers or an assistant foreman.

The foreman has general supervision over all the gangs and is expected to spend a large percentage of his time in the field. The assistant foreman takes charge in the field of major repairs, and supplements the foreman's supervision of field work. A clerk assigned to each company, except the small companies in Queens and Richmond, records time, material and labor expended on each job, complaints received and action thereon, etc.

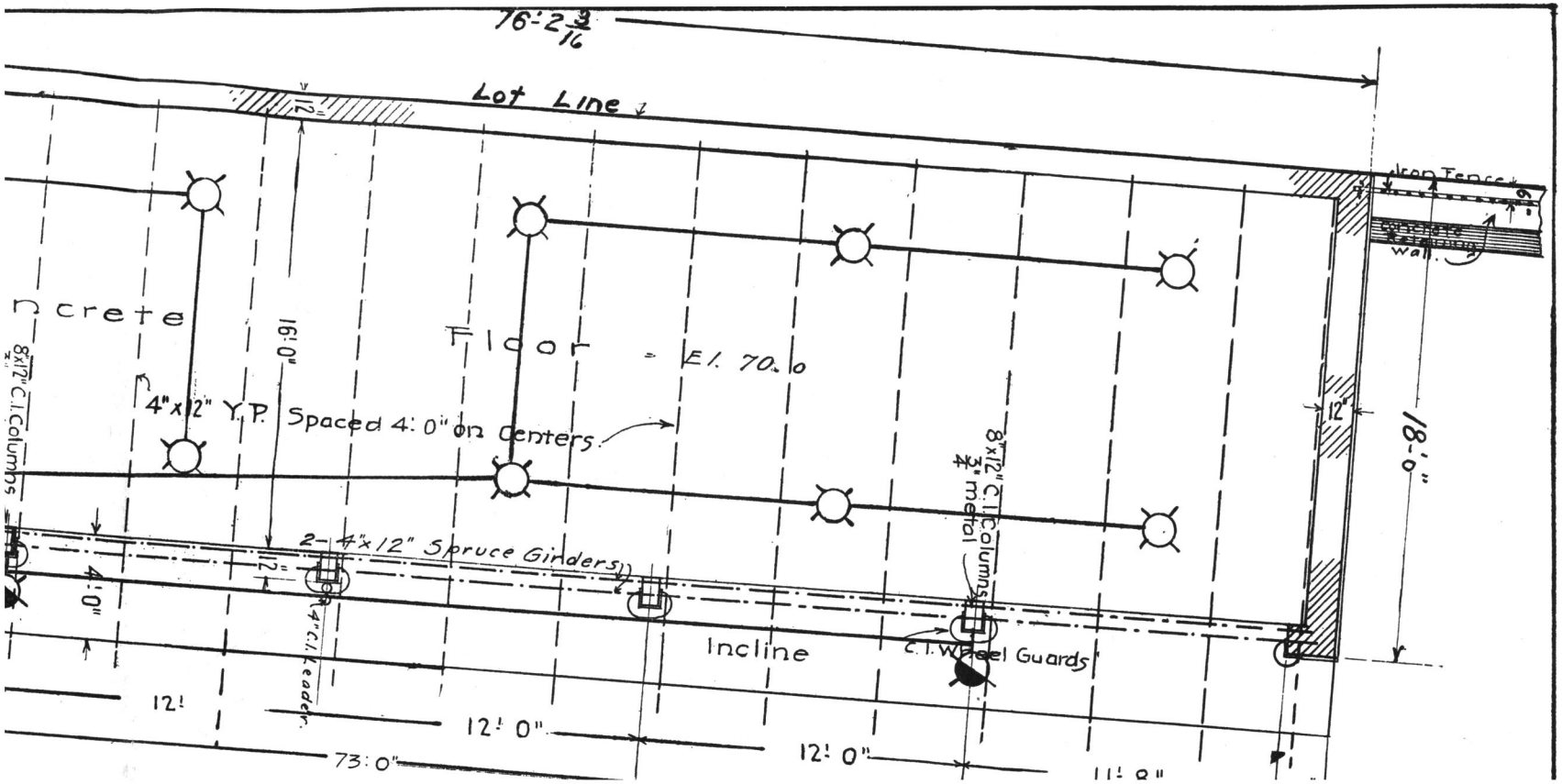
Repair Company Headquarters

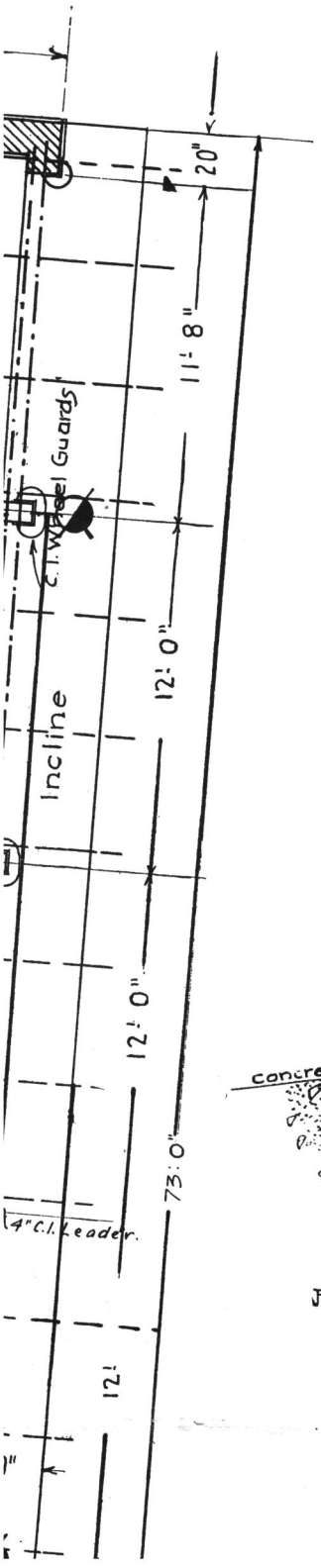
In general, the buildings used for repair company headquarters are inadequate; only one modern building, that on East 24th Street, being now in use. Efforts are being made to remedy this condition. One new building in Manhattan and two in Brooklyn are nearing completion and plans have been prepared and money authorized for three additional buildings for headquarters in Brooklyn, Queens and Richmond, respectively.

TABLE 3

Repair companies—Area covered and cost of payroll per hydrant and per mile of main

REPAIR CO.	NO. MEN		PAYROLL	AREA COVERED (SQ. MILE)	MILES OF MAINS =12″ MAIN	NO. HYDRANTS	NO. VALVES	COST PER MILE	COST PER HYDRANT
	Skilled	Unskilled							
Manhattan and Bronx									
Worth Street	7	36	50,675	3.3	113.5	2744	3201	$446	$18
35th Street	5	28	35,355	2.1	107.5	1625	2085	329	22
24th Street	2	30	37,259	2.1	97.7	1916	2440	381	19
87th Street	3	26	32,954	7.4	254.2	2945	3304	130	11
Harlem	3	30	37,155	5.0	365.2	2791	3137	102	13
Ft. George	1	13	16,367	2.1	48.9	831	1212	335	20
South Bronx	2	35	40,732	8.8	167.7	3567	4290	243	11
North Bronx	2	27	31,951	9.3	175.7	1847	2532	182	17
Westchester	3	17	22,978	22.1	93.0	1787	2079	247	13
High Pressure	2	23	27,999	5.8	126.1	2369	4062	222	12
Brooklyn									
Western District	9	73	78,726	13.5	353.0	5514	6866	223	14
Eastern District	4	47	48,260	6.54	158.0	2786	4637	305	17
East N. Y. Dist	5	44	48,822	10.56	173.0	2494	2509	282	20
Coney Island	3	36	45,975	24.1	219.0	6316	5789	210	7
High Pressure	1	10	10,825	4.8	51.0	1247	1727	212	9
Queens									
First Ward	2	23	22,318	8.0	80.0	1229	1224	278	18
Third Ward	1	18	17,401	34.0	90.0	1197	2203	192	15
Richmond									
West New Brighton	1	14	14,213	13.4					
Clove	1	14	14,003	23.0	175.0	2332	4282	242	18
Tottenville	1	10	10,398	21.0					


76'-2 3/16"
Lot Line
Iron Fence
6'-0"
Retaining wall
Concrete Floor = El. 70.10
8"x12" C.I. Columns
4"x12" Y.P. Spaced 4:0" on Centers
16'-0"
12"
18'-0"
8"x12" C.I. Columns 3/4" metal
2-4"x12" Spruce Ginders
4'-0"
12"
6"x4" C.I. Leaders
Incline
C.I. Wheel Guards
12'
12'-0"
12'-0"
73:0"



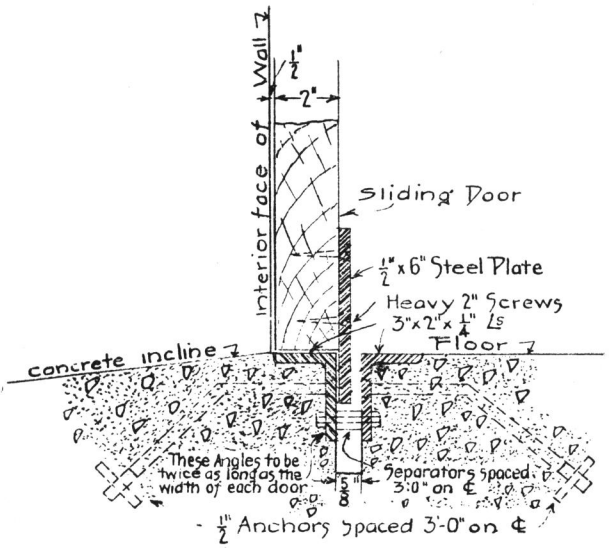
ELECTRIC LIGHTING SYMB

CEILING FIXTURE, 100 WATTS.

INSERTION PLUG RECEPTACLE, 100 W

S. SWITCH

WEATHER-PROOF FIXTURE AS SPECIFIE



DETAIL OF FLOOR GUIDE
FOR EXTERIOR SLIDING DOORS.

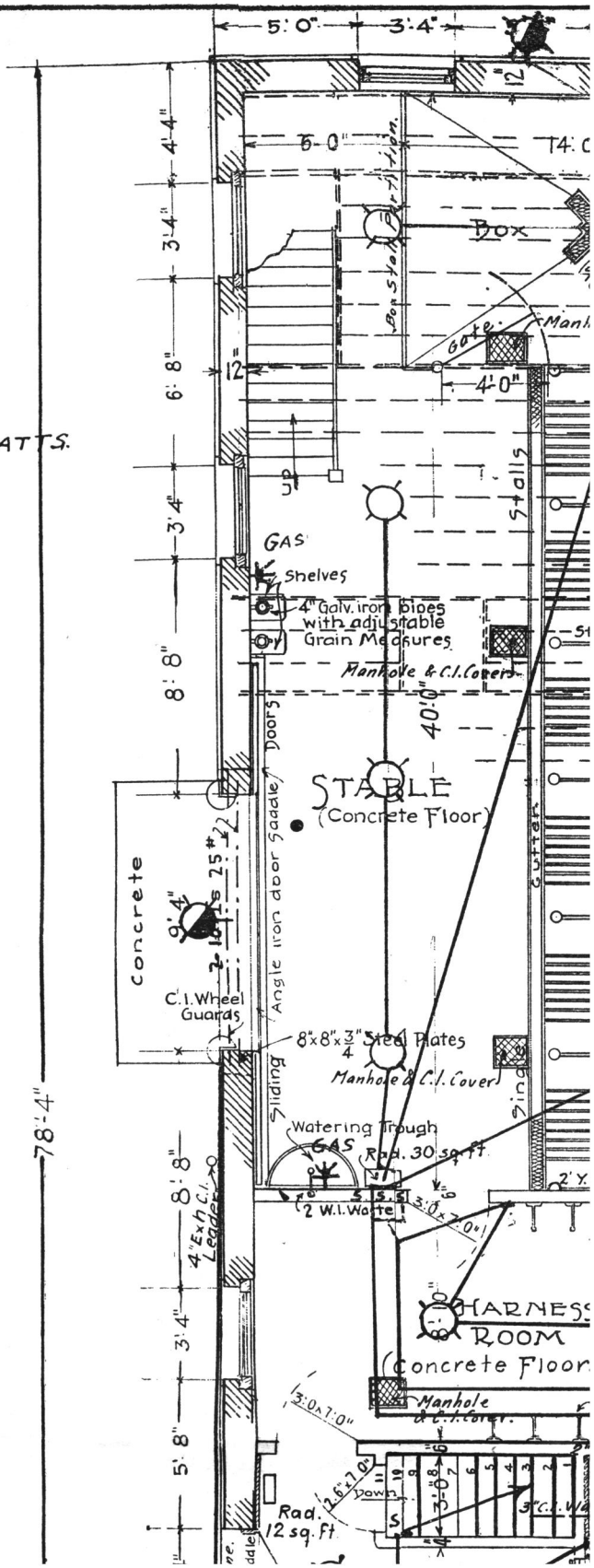
SCALE 3 in. = 1 ft.

ING SYMBOLS:

WATTS.

TACLE, 100 WATTS.

E AS SPECIFIED, 100 WATTS.

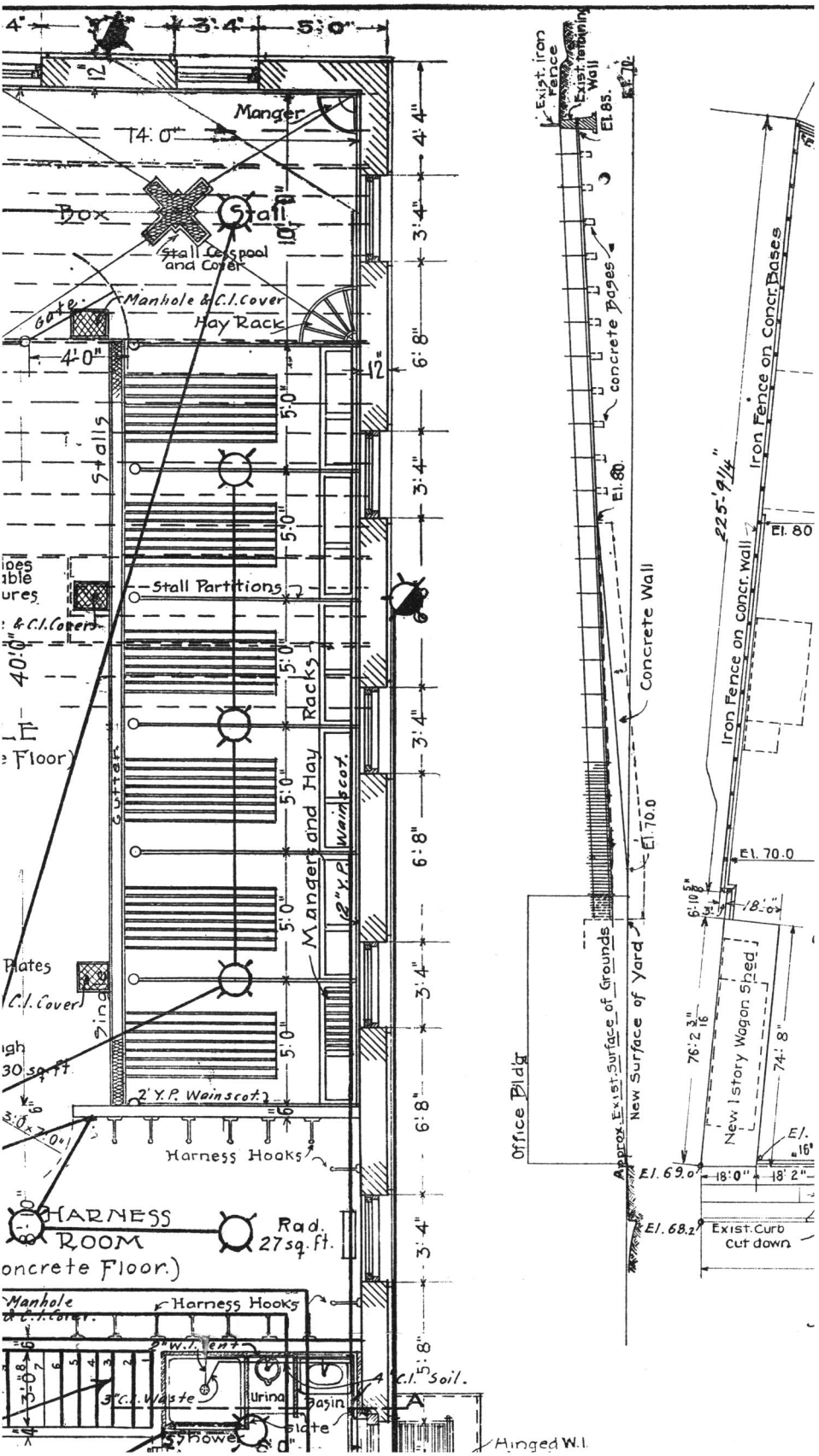


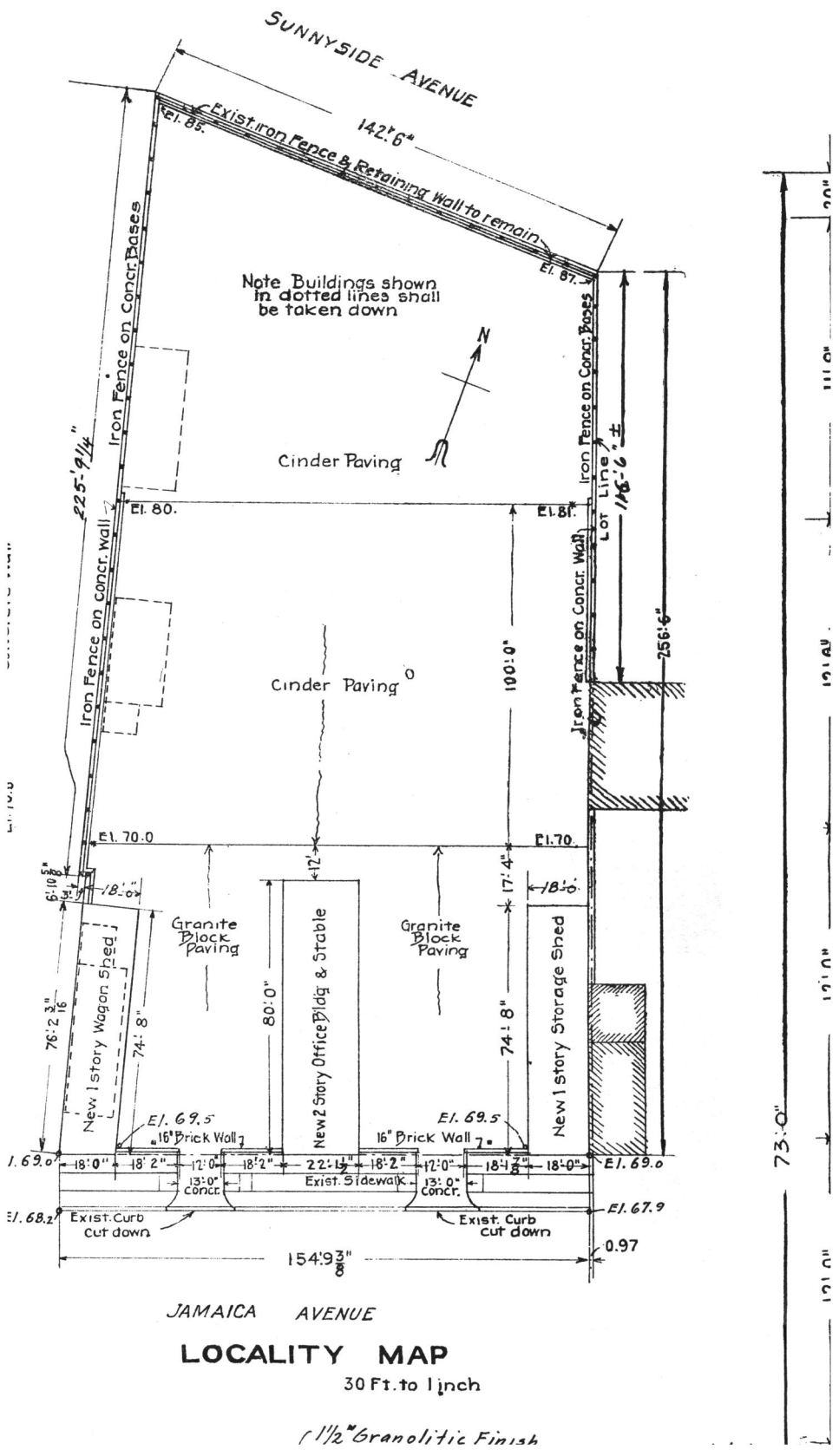
e

ws

ORS.

= 1ft.


Manger
Box Stall
Stall Cesspool and Cover
Manhole & C.I. Cover
Hay Rack
5 Stalls
Stall Partitions
Racks
Manger and Hay
2' Y.P. Wainscot
Harness Hooks
HARNESS ROOM
Rad. 27 sq. ft.
Manhole
Harness Hooks
3" W.I. Vent
3" C.I. Waste
Urinal
Basin
Slate
Shower
4" C.I. Soil.
Hinged W.I.
Exist. Iron Fence
Exist. retaining Wall
El. 85.
Concrete Bases
El. 80.
Concrete Wall
El. 70.0
Office Bldg
Approx. Exist. Surface of Grounds
New Surface of Yard
Iron Fence on Concr. Bases
225'-9 1/4"
Iron Fence on concr. wall
El. 80
El. 70.0
18'-0"
New 1 Story Wagon Shed
76'-2 3/16"
74'-8"
El. 69.0
18'-0"
18'-2"
El. 68.2
Exist. Curb Cut down

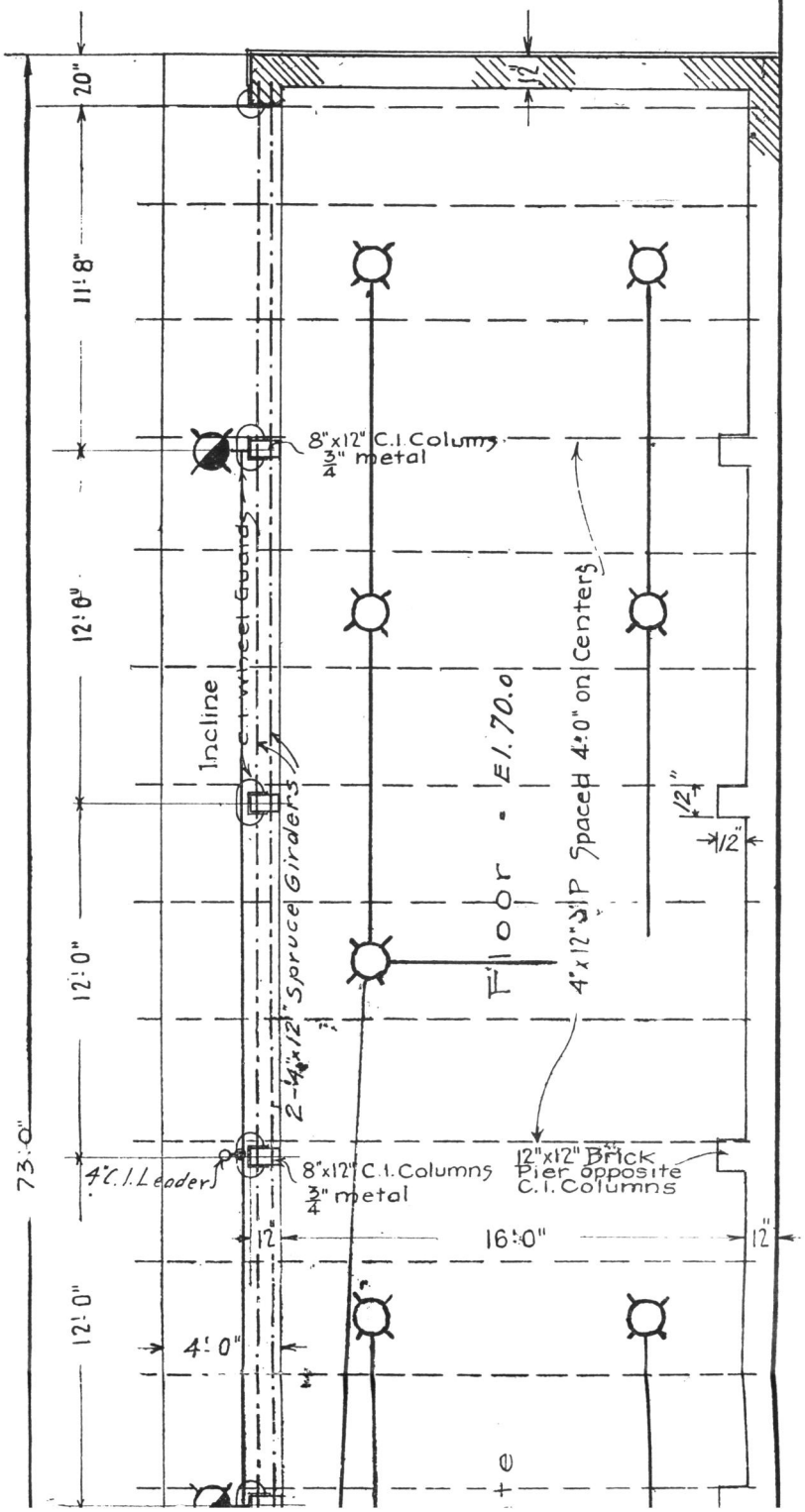


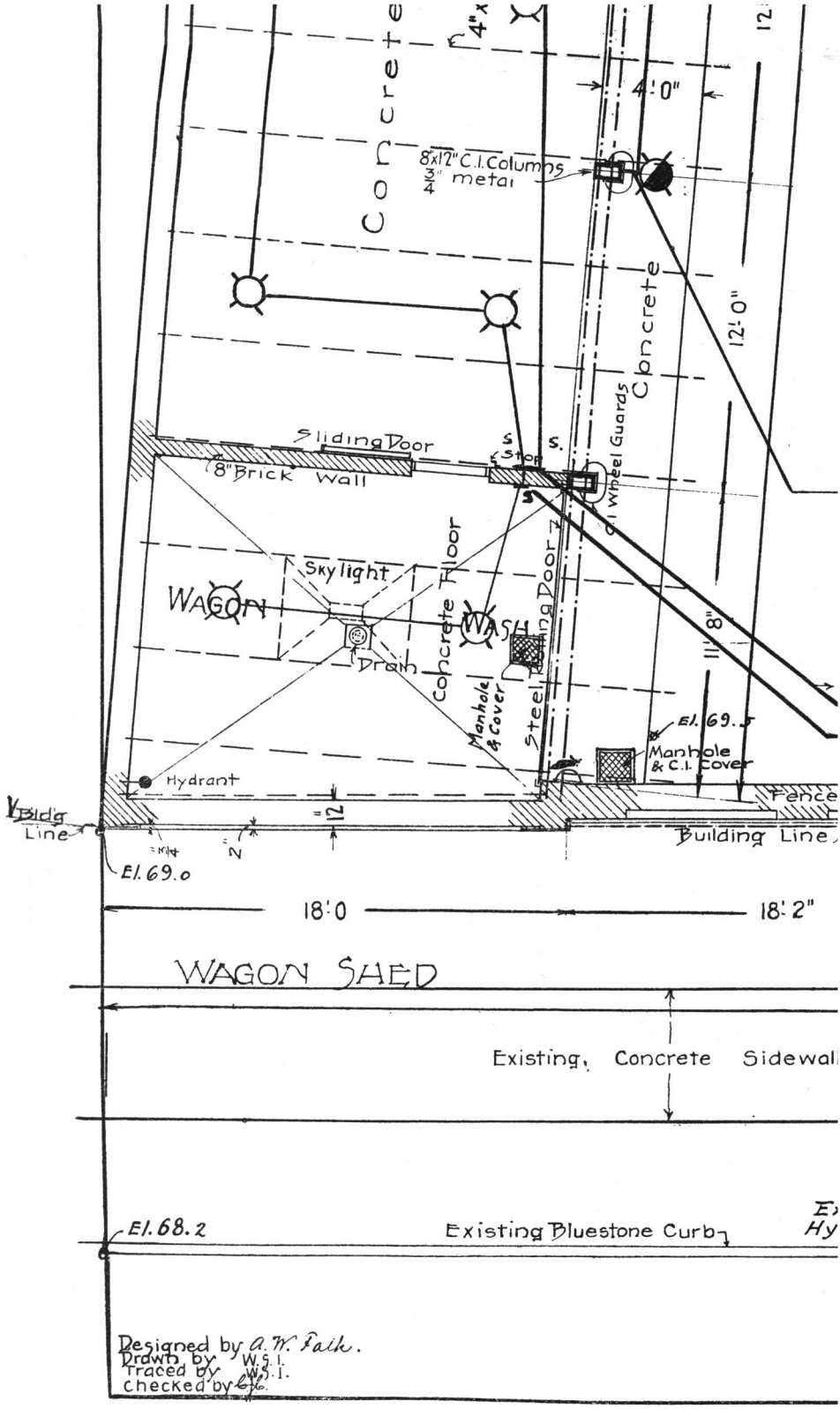
LOCALITY MAP

30 Ft. to 1 inch

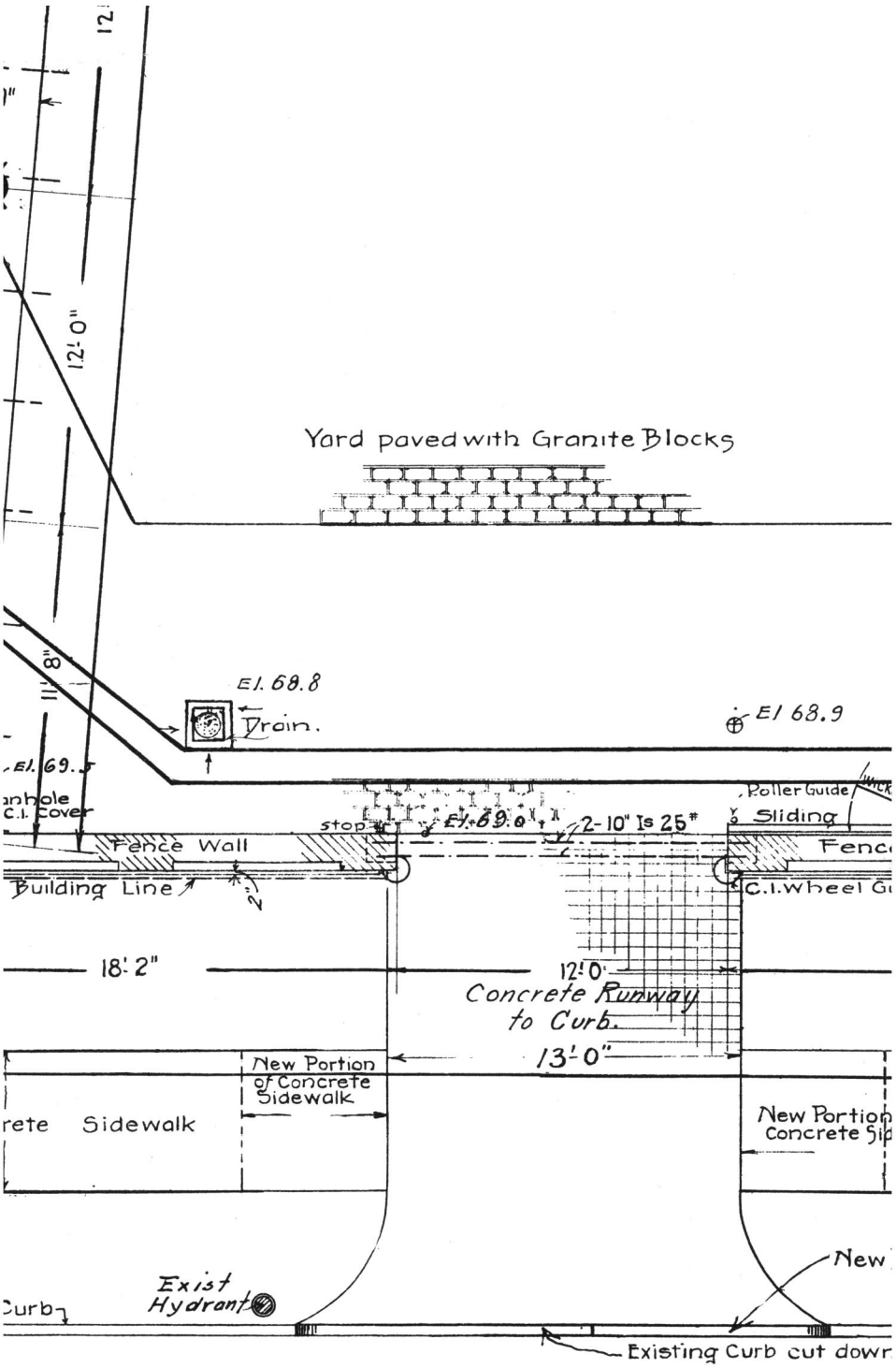
(1 1/2" Granolitic Finish

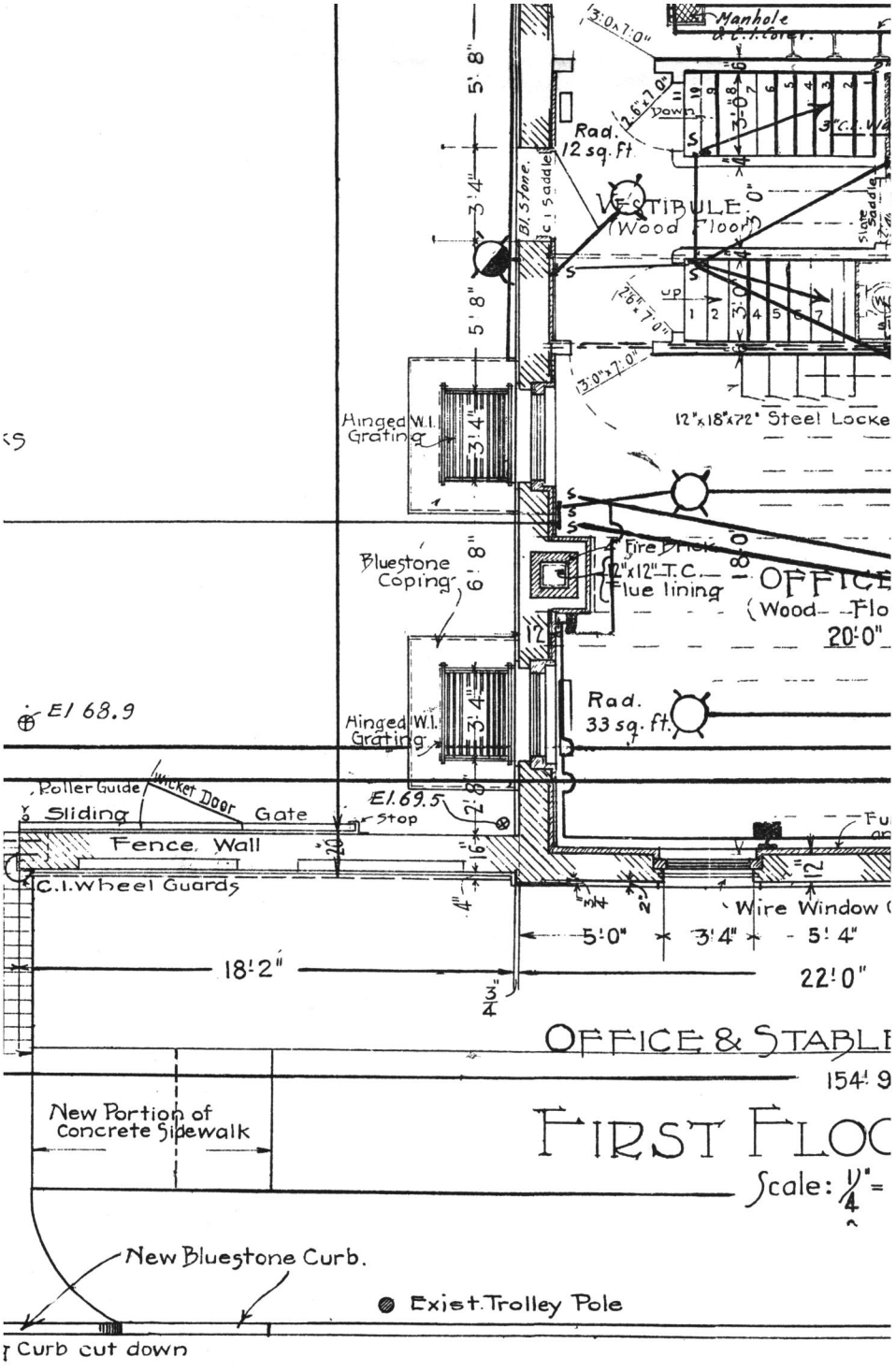
Sheet No. 2
5 Sheets in Set

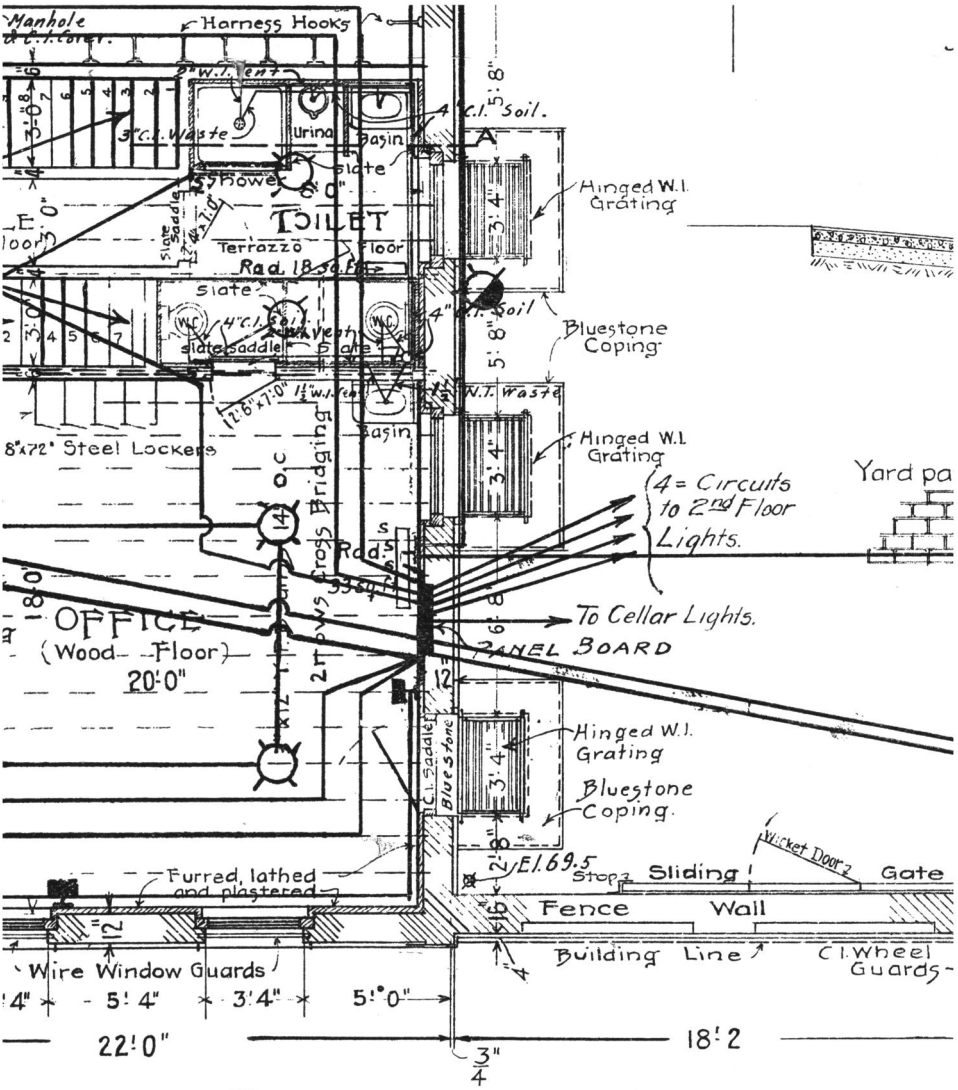


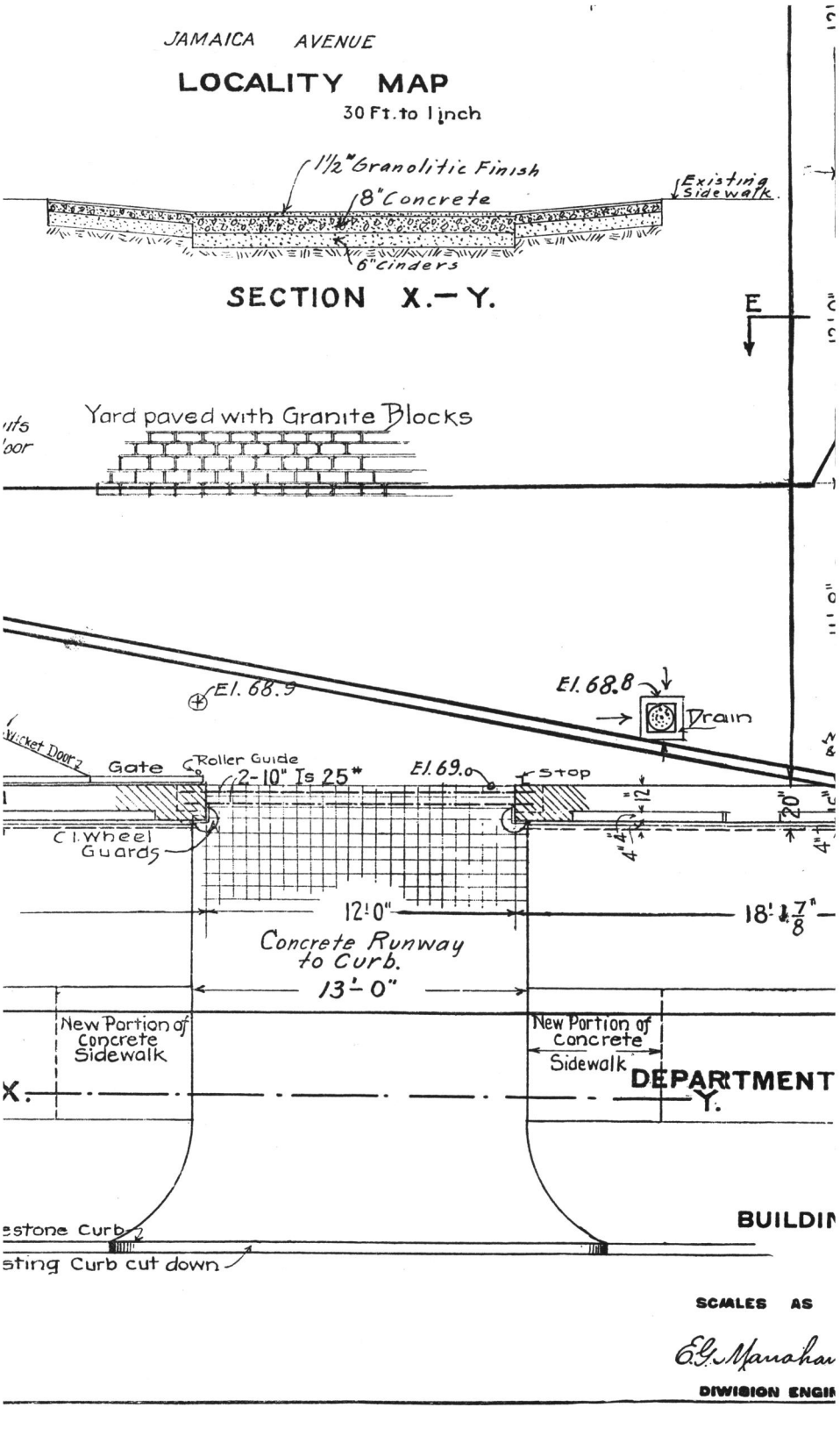


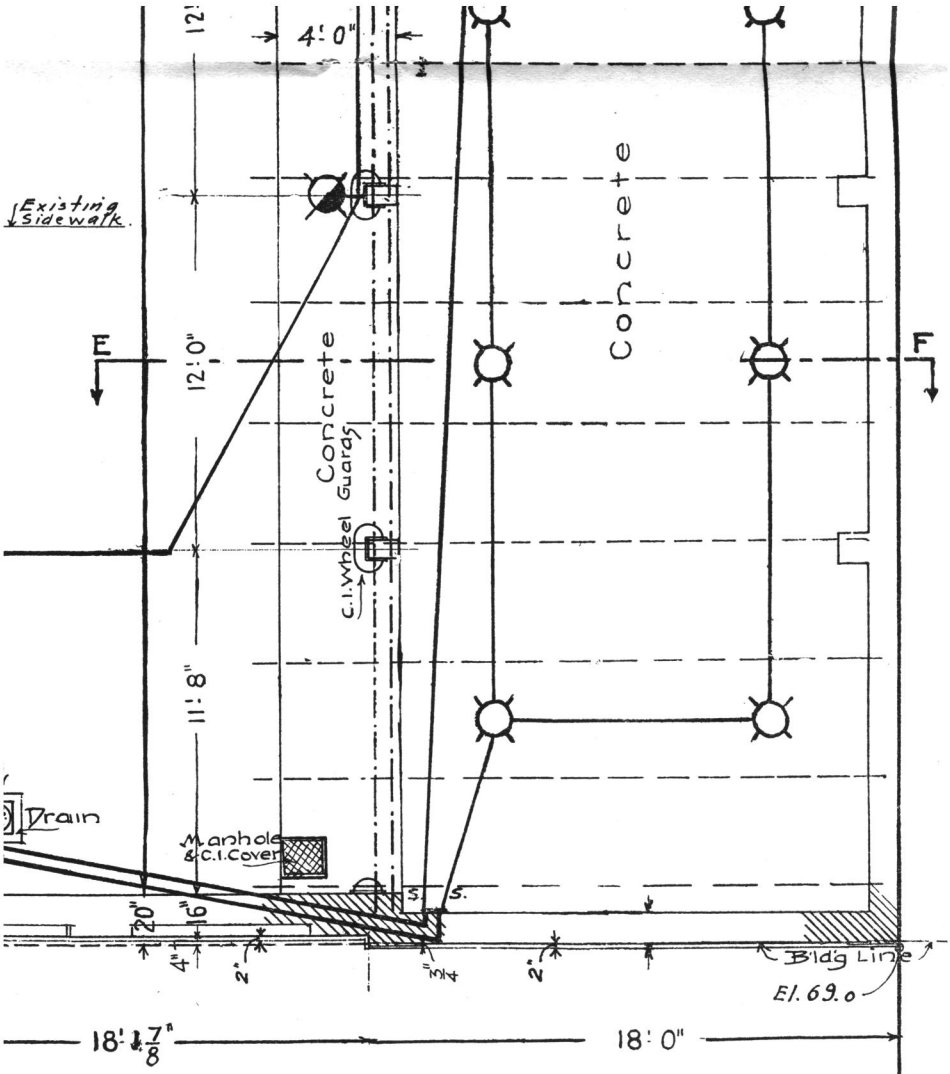
Designed by A. W. Faik.
Drawn by W.S.I.
Traced by W.S.I.
checked by Etc.


12"
12'-0"
Yard paved with Granite Blocks
El. 68.8
Drain.
El 68.9
El. 69.
anhole
C.I. Cover
Roller Guide
Sliding
stop
El. 69.0
2-10" Is 25#
Fence Wall
Fenc
Building Line
C.I. Wheel G
18'-2"
12'-0"
Concrete Runway
to Curb.
13'-0"
New Portion
of Concrete
Sidewalk
rete Sidewalk
New Portion
Concrete Sid
New
Curb
Exist
Hydrant
Existing Curb cut down


Manhole
C.I. Cover.
3'0"x7'0"
Rad.
12 sq. ft
Bl. Stone.
C.I. Saddle
VESTIBULE
(Wood Floor)
Slate Saddle
2'6"x7'0"
Down
Hinged W.I. Grating
12"x18"x72" Steel Locke
Bluestone Coping
Fire Brick
12"x12" T.C. Flue lining
OFFICE
(Wood Flo
20'0"
Rad.
33 sq. ft.
El 68.9
El. 69.5
Roller Guide
Wicket Door
Sliding Gate
Stop
Fence Wall
C.I. Wheel Guards
Wire Window
5'0"
3'4"
5'4"
18'2"
22'0"
OFFICE & STABLE
154' 9
New Portion of Concrete Sidewalk
FIRST FLOO
Scale: 1/4"=
New Bluestone Curb.
Exist. Trolley Pole
Curb cut down


Manhole
Harness Hooks
Urinal
Basin
Slate
TOILET
Terrazzo Floor
Rad. 18.50 Ft.
Hinged W.I. Grating
Bluestone Coping
Basin
8"x72" Steel Lockers
Cross Bridging
OFFICE
(Wood Floor)
20'0"
To Cellar Lights.
PANEL BOARD
4 = Circuits to 2nd Floor Lights.
Yard pa
Furred, lathed and plastered
Wire Window Guards
Sliding Gate
Fence Wall
Building Line
C.I. Wheel Guards
22'0"
18'2
& STABLE BUILDING
154' 9 3/8"
FLOOR PLAN
Scale: 1/4" = 1'0"
Existing Concrete Sidewalk
New Portion Concrete Sidewalk
Existing Bluestone Curb
Existing Curb cut


JAMAICA AVENUE
LOCALITY MAP
30 Ft. to 1 inch
1½" Granolitic Finish
8" Concrete
6" Cinders
Existing Sidewalk
SECTION X.—Y.
E
Yard paved with Granite Blocks
El. 68.9
El. 68.8
Drain
Wicket Door
Gate
Roller Guide
2-10" Is 25#
El. 69.0
Stop
Cl. Wheel Guards
12'0"
Concrete Runway to Curb.
13'-0"
18'-7 7/8"
New Portion of Concrete Sidewalk
New Portion of Concrete Sidewalk
DEPARTMENT
X.
Y.
BUILDIN
estone Curb
sting Curb cut down
SCALES AS
E.G. Manahan
DIVISION ENGI



STORAGE SHED

CITY OF NEW YORK

DEPARTMENT OF WATER SUPPLY, GAS & ELECTRICITY

BOROUGH OF BROOKLYN

CONTRACT DRAWINGS

FOR

BUILDINGS AT EAST NEW YORK PIPE YARD

NO. 137 JAMAICA AVENUE

SCALES AS SHOWN

NOVEMBER 1913

E.G. Manahan

DIVISION ENGINEER

CHIEF ENGINEER

B-224 FILE B

Plate No. 1 shows the ground and second floor plan of the East New York headquarters in Brooklyn, and Plates Nos. 2 and 3 are photographs of this building which is nearing completion.

Plate No. 4 is a photograph of the 24th Street Station, which serves as headquarters for a repair company, the meter testing shop, garage, blacksmith shop, machine shop and store yard.

Headquarters, such as that erected at East New York Station, cost about $25,000, exclusive of land, and can adequately provide for a force of forty men, six horses and six wagons, or automobiles. Space is provided under the sheds for the storage of valves and hydrants, it being expected that pipe and special castings would be stored in the open.

Equipment, Materials and Supplies

There is a natural tendency to hoard articles which may at some time be useful and which one may have had difficulty in obtaining in the past. Foremen in charge of repair companies have this very human trait, and the resulting accumulation of useful and useless material makes for confusion and inefficiency. As a corrective, a standard quota is set up for each repair company, the same quota being used where companies are of approximately equal size. This quota represents the equipment, materials and supplies, that should always be on hand, plus about one months' consumption of the materials and supplies. After such quota has been fixed, the surplus at each headquarters is removed and sent to a central storehouse, where it is placed in stock, or consigned to the scrap heap, if it is useless. At approximately the end of the month, the clerk makes a list of all equipment, materials and supplies consumed during the month and requisitions the storekeeper for such articles to replenish the depleted quota. If there is any unusual demand, the quota can be replenished at any time.

The tentative quota of equipment as shown in Table No. 4 may be useful for those who are setting up a similar standard.

Standardizing Materials, Pipe, Valves and Hydrants

All materials are purchased under definite specifications and are subjected to chemical and physical tests to determine compliance with standards. Samples are used as standards where it is difficult, if not impossible, to set up definite specifications.

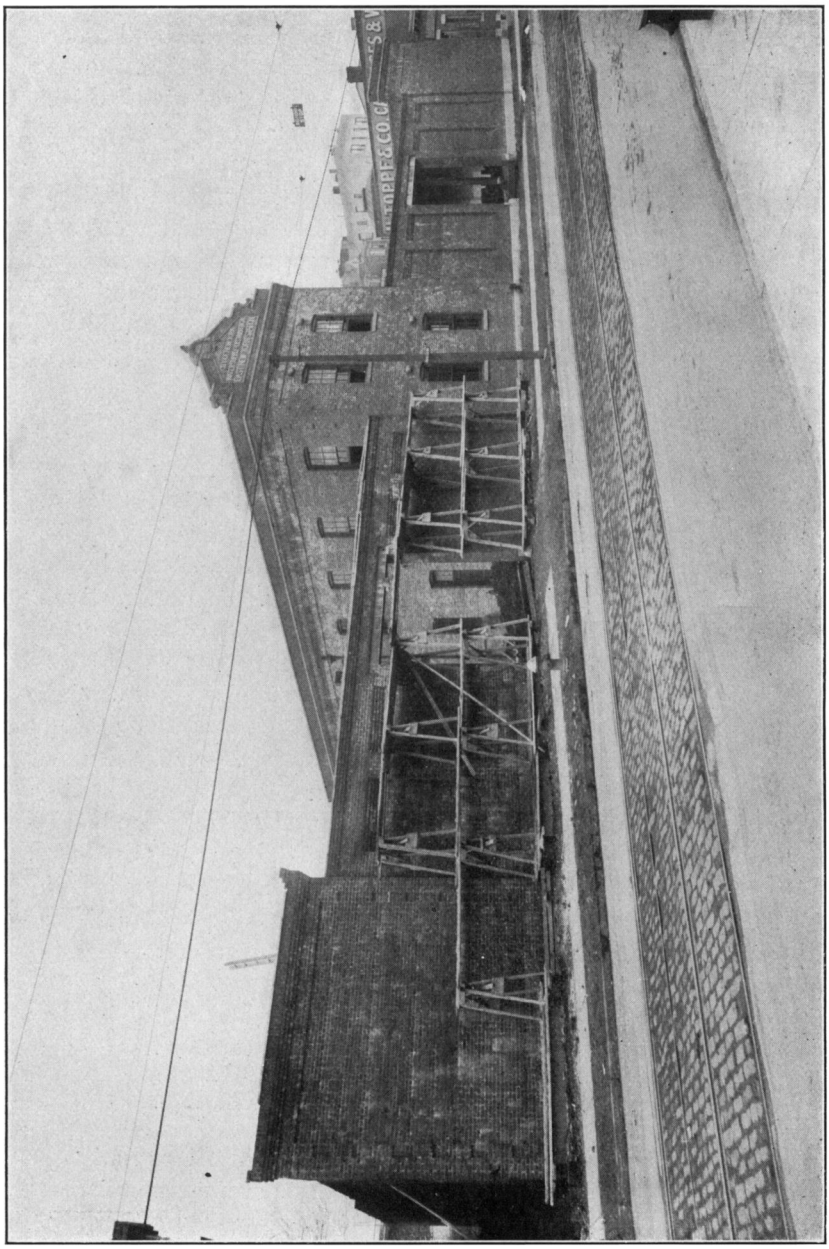


PLATE 2. EAST NEW YORK REPAIR YARD, BOROUGH OF BROOKLYN. EXTERIOR VIEW. UNDER CONSTRUCTION

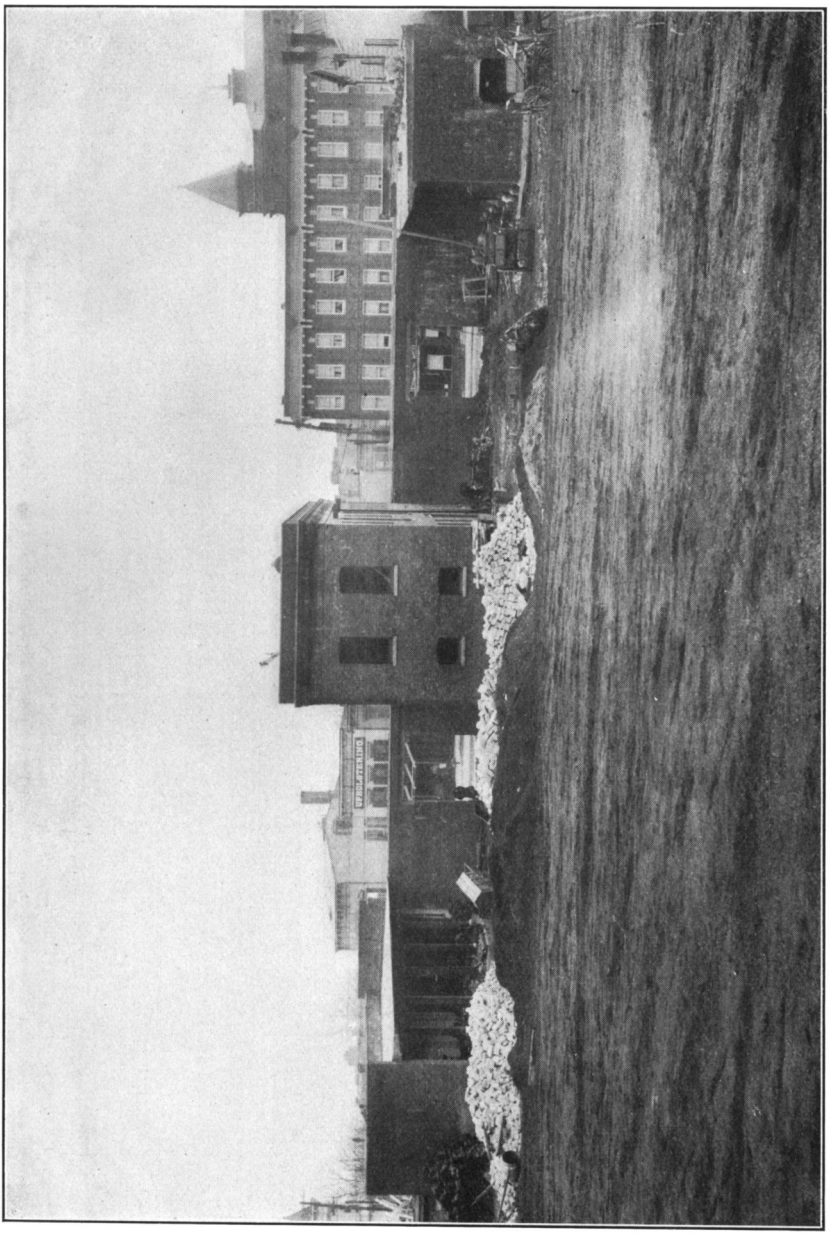


PLATE 3. EAST NEW YORK REPAIR YARD, BOROUGH OF BROOKLYN, UNDER CONSTRUCTION. CENTRAL TWO STORY BUILDING TO BE USED FOR OFFICE, HEADQUARTERS FOR MEN, STOREROOM AND STABLE. ONE STORY SHEDS FOR STORAGE OF WAGONS, AUTOMOBILES, HYDRANTS, VALVES AND HEAVY MATERIAL

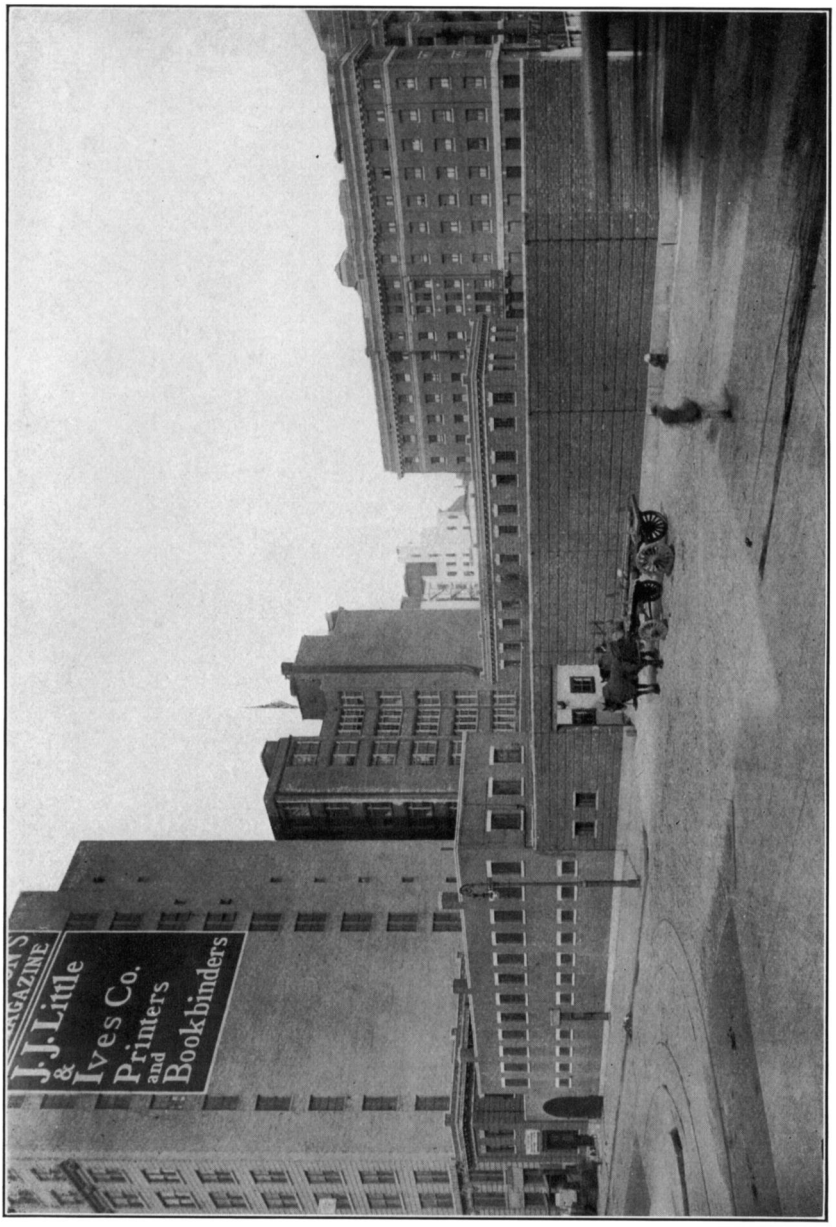


PLATE 4. EAST 24TH STREET YARD, BOROUGH OF MANHATTAN. HEADQUARTERS FOR REPAIR COMPANY, METER SHOP, STOREROOM AND GARAGE

TABLE 4

Standard quota of equipment for repair companies.
Manhattan and the Bronx
February 8, 1915

For office use:	
Mops, complete	2
Mop wringer	1
Whisk brooms	2
Duster	1
Corn brooms	2
Fire extinguishers	2
Ash cans	2
For shop use:	
Buck saw	1
Saw horse	1
Garden hose, feet	50
Step ladder	1
Platform scale	1
Anvil	1
Kerosene cabinet	1
Iron rake	1
Work bench	1
Vice (combination)	1
Breast drill	1
Stock and dies (for pipe thread)	3
Stock and dies (for machine thread)	3
Ratchet brace and set of bits	1
Draw knife	1
Spirit level	1
Grindstone	1
For general use:	
Rubber boots (for each man)	
Rubber hats (for each man)	
Oil suits for all, except foremen	
Rubber coat for each foreman	
Axes, 3-pound	3
Axes, 5-pound	3
Hatchets	3
Aquaphones	2
Crow bars, 6-foot	3
Telegraph bars, 6-foot	3
Pinch bars, 4-foot	2
Cutters (bull point)	12
Brushes (casting)	3
Cutters (asphalt)	12
Hook chains, $\frac{1}{2}$-inch x 12 feet	2
Hook chains, $\frac{3}{4}$-inch x 12 feet	2
Cutters, pipe	2

TABLE 4—Continued

For general use—Continued:

Derrick, 1-ton	1
Derrick, 2-ton	1
Rope chain slings	2
Rope slings for 12–20 and 36-inch pipe, 2 of each	2
Files, 8–10 and 14-inch, 3 each of the following, bastards, half round, hand and square, second cut (flat)	3
Files, saw (8-inch)	3
Hydrant pressure gauges and connections	6
Striking hammers	6
Malls	2
Mortar hoes	2
Water hose, 2½-inch, feet	50
Hydrant pumps	2
Furnace (plumber's)	1
Furnace, 18-inch caulker's	1
Gate keys (different lengths)	12
"Wells" lights	2
Lanterns, dozen	5
Search lights (electric)	2
Ladles, 9-inch	2
Ladles, 7-inch	2
Pouring pots and hooks	2
Melting ladles and tripods	2
Ditch pumps (G. I.)	2
Dia. pumps, No. 2 (complete)	2
Dia. pumps, No. 3	2
Dia. pump, gas driven	1
Picks, dozen	1
Pails (G. I.)	6
Rammers	6
Asbestos joint runner, 48-inch	1
Asbestos joint runner, 30-inch	1
Asbestos joint runners, 20-inch	2
Asbestos joint runners, 12-inch	2
Asbestos joint runners, 8-inch	4
Asbestos joint runners, 6-inch	4
Shovels (D. handle R. P.)	15
Shovels (L. handle R. P.)	4
Shovels (D. handle sq. p.)	6
Shovels (L. handle sq. p.)	6
Telegraph spoons	2
Screw drivers, 24-inch	4
Screw drivers, 6-inch	2
Sledges, 24-pound	3
Sledges, 20-pound	3
Wheel tool box	1

TABLE 4—Continued

For general use—Continued:	
Trowels	3
Tape, 50-foot	2
Rule, folding	6
Pipe vise (portable)	2
Street brooms	6
Wrenches (monkey, 6- to 18-inch)	9
Wrenches (Stillson 8- to 26-inch)	9
Wrenches, hydrant	12
Wrenches, special for various makes of hydrants	
Saw, two-man	2
Saw, cross-cut	2
Saw, hack	3
Pliers, 4-inch, pairs	3
Pliers, 12-inch, pairs	3
Tin snips, pair	1
Soldering iron (1-pound)	1
Extra length of 2½- and 3-inch suction hose with strainer, each	1
Caulking tools and implements (for each caulker employed)	
Hammer	1
Yarning irons	2
Chisels (small bursting)	2
Chisels (lifting)	2
Chisels (cold)	2
Chisel (dog)	1
Chisel (dog diamond point)	1
Chisels (hand diamond point)	2
Wedges, large bursting	2
Hammer (3½-pound)	1
Tool bag	1

The sizes of pipe used are 6-inch, 8-inch, 12-inch, 16-inch, 20-inch, 24-inch, 30-inch, 36-inch, 48-inch, 60-inch, 66-inch. For sizes above 48 inches steel is generally used; while for 48 inches and smaller sizes, cast iron is adopted. The pipe and specials are made from department designs, although the writer believes that a change to American Water Works Association standards for the pipe at least, will be made before long.

Valves are made from department design under definite specifications. The sizes adopted are 6-inch, 8-inch, 12-inch, 20-inch, 36-inch and 48-inch. Intermediate sized mains have valves with reducers. Thus, 36-inch valves are used on 48-inch and 36-inch mains, 20-inch valves on 30-inch, 24-inch and 20-inch mains, 12-inch valves on 16-inch and 12-inch mains. This practice requires

fewer valves in stock, greater ease and speed in operation of valves and less parts for repairs. The additional loss in head, due to contraction of waterway is negligible. Thus, with a velocity in the main of three feet per second, the loss at the valve, due to placing a 20-inch valve on a 30-inch main, is about a half an inch, while the frictional loss per 1000 feet would be about a foot. As valves are only placed at intervals of about 2000 feet on the larger mains the effect is not practically measurable.

The use of department designed valves has not materially increased the cost, as the prices quoted for valves delivered during the past year have been approximately as follows: these valves being a heavy bronze stem bronze mounted type:

Size In.	*Av. Cost*	*Size In.*	*Av. cost*
4	$8.00	12	$31.00
6	12.00	16	65.00
8	18.50	20	115.00

The hydrants used are also manufactured from department drawings and specifications. The body is 8 inches in diameter, with one $2\frac{1}{2}$-inch and one $4\frac{1}{2}$-inch outlet. These hydrants manufactured of high grade materials, and under careful inspection are now delivered at less than $25 per hydrant.

To receive all equipment, materials and supplies, and care for same before use, three general store yards have been established, one in Manhattan to serve Manhattan, The Bronx and Queens, and one each in Brooklyn and Richmond to serve those boroughs. For pipe, special castings and other heavy materials additional yards have been established in each borough.

Machine Shops

Repairs to valves, hydrants and other appurtenances require machine work which is carried out in a well equipped shop in Brooklyn, where eight machinists and an equal number of helpers are employed. In Manhattan, less work of this character is performed by the city force, and only two machinists and helpers are assigned to distribution work. The Brooklyn shop is headquarters for the automobile repairs and as the department has over thirty cars with approximately as many more to be purchased in 1915, this part of the work is important.

Meter Shops

Under the New York City charter, meters are furnished and set by property owners upon the direction of the department. Under present regulations the department cannot require meters to be set except where water is used for business purposes. The meter rate is 10 cents per 100 cubic feet, irrespective of quantity used. This rate is approximately double the average income per million gallons delivered into the mains. It is therefore to be expected, as the frontage rate is in general materially less than meter rates, that meters will not be set except upon the order of the department. There are approximately 90,000 meters in use in the city. The charter further requires that all meters shall be of a type and sold at a price approved by the Board of Aldermen, upon recommendation of the commissioner of the department. There are seventeen makes of meters approved, thus affording the consumer a wide range in choosing his meter.

Before meters are set they must be tested for accuracy at one of the department shops, no charge being made for such test. After being set they are subject to retest at such times as may be directed by the department. The department does not make any repairs to meters, but requires the plumber to remove the meter, attend to the repairs and deliver the meter to the meter shop for test and certification. These meter shops are equipped with modern appliances, the installation at the 24th Street shop, Manhattan, where the majority of meters are tested, being shown by photograph, Plate No. 5. Large meters, above 2 inches in diameter, are frequently tested on the premises without moving same, by the installation of a test tee on the delivery line just beyond the meter and the use of a portable test meter which is attached by the inspector to the test-tee outlet. Where a large meter is found to be registering incorrectly the same may be repaired either in place or removed for repairs, at the option of the owner. The number of meters tested annually by each shop is as follows:

Manhattan	Premises	2547
	Shop	18196*
Bronx	Premises	738
	Shop	2177

* Includes meters sent from Queens and Richmond.

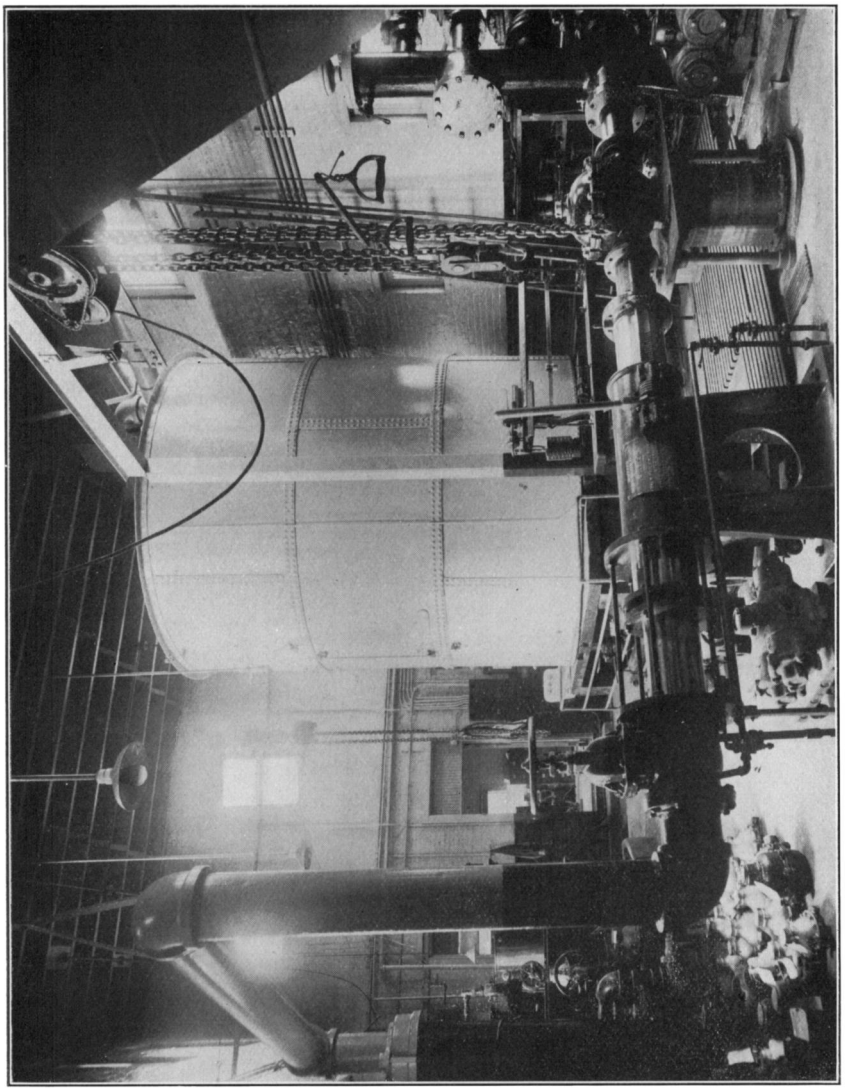


PLATE 5. EAST 24TH STREET YARD, BOROUGH OF MANHATTAN. INTERIOR OF METER TESTING SHOP

Brooklyn	Premises	2039
	Shop	6803
Queens	Premises	38
	Shop	—
Richmond	Premises	35
	Shop	—

The force employed in the Manhattan shop, where the largest amount of work is done, is as follows:

1 Inspector	$1500
2 Inspectors	1100
1 Clerk	900
1 Stenographer	1050
1 Plumber	5.50 a day
1 Machinist's Helper	3.00 a day
5 Laborers	2.50 a day

TRANSPORTATION

Until approximately 1913, all transportation was by horse-drawn vehicles, city owned horses and vehicles being used in the boroughs of Brooklyn and Richmond and hired horses and vehicles in the other three boroughs. This difference resulted from continuation of practices followed before consolidation in 1898, there being no local transportation conditions which warranted a different system in one borough as compared with another.

The development of the automobile has resulted in a change in policy and light auto runabouts, with small wagon bodies, are used for the foremen, tappers and for light material, while auto trucks are being substituted for the horse-drawn trucks. The horse-drawn and motor-driven types are illustrated in photograph, Plate 6. It is estimated that the cost of transportation by horse-drawn and by motor-driven vehicles is approximately the same, based on mileage. The load transported, however, is mainly labor, and therefore the saving in time should be multiplied by the number of men transported, which is usually six to each gang. The main advantage in the use of motor vehicles is in the reduction in time in responding to emergency calls, and the resultant reduction in damage caused by breaks in large mains, and the much more efficient supervision by the foremen, where automobiles are available.

The department records on automobile service show the following

PLATE 6. AUTOMOBILE RUNABOUT USED FOR FOREMEN, TAPPERS AND LIGHT REPAIR WORK. HORSE DRAWN WAGON. THESE WAGONS BEING REPLACED BY MOTOR TRUCKS

cost per mile for runabouts, touring cars and trucks, exclusive of the cost of driving:

Runabouts	4.6 cents per mile
Touring cars	7.7 cents per mile
Trucks	6.3 cents per mile

The touring cars are used by the superintendent and assistant engineers in charge of maintenance work.

The department has one three-horse truck, which has sufficient carrying capacity to handle any pipe or valve that might be required for repair or extension work, and it is proposed to continue this truck in use for emergencies even though automobiles may be substituted for all other transportation.

METHOD OF REPORTING REPAIRS REQUIRED

When a complaint is received at a repair company's headquarters, entry is made in a blotter kept for the purpose and the complaint is transmitted by telephone to the borough office. Here a complaint slip is made out in triplicate, two copies being forwarded to the repair company's headquarters, the third being retained as an office record. If a complaint is received directly at the borough office, a similar complaint slip is made out and forwarded to the repair company. The form of slip used is reproduced on plate No. 7. Each complaint is given a job number and all time and material consumed is charged to that job. When the complaint has been attended to, the clerk at the yard notes the action taken on the complaint slip and the duplicate is returned to the borough office. The record of material and time charged to the job is sent to the division of costs and statistics, which records all departmental expenditures.

Immediate action on complaints of an urgent character is taken by the foreman in charge of the repair company, the regular complaint slip being later forwarded to headquarters.

In the borough office there is a street map, mounted on soft wood, and pins with varicolored heads are daily placed at the locations of the different complaints. The assignments of gangs to jobs for the following day are also shown on this map; so that it can be determined at a glance the number and kind of complaints that have not yet been attended to, as well as the location of each gang.

Distribution Division Form No. 1b ORDER ON REPAIR COMPANY 38 D-1-14 (B) 7500

CITY OF NEW YORK

DEPARTMENT OF WATER SUPPLY, GAS AND ELECTRICITY

BUREAU OF WATER SUPPLY

ORDER No..... COMPANY No.....

Com. No.	Ch. Eng. No.	Page No.

Received 191 , M., from

Sent on 191 , M., to Foreman of Repair Company

Assigned on 191 , M., to

Location

Complaint

REPORT

.....

Foreman.

PLATE 7—COMPLAINT SLIP

For the high pressure fire system, the procedure provides for notification of the fire department of all changes which affect that part of the system. If, for any cause, a hydrant cannot be utilized, a chain is attached thereto, carrying a metal tag on which are inscribed the words "Out of Order."

In general, the repair work is kept up so that routine repairs are made within two or three days from the receipt of complaint and emergency repairs are, of course, attended to immediately.

Taps

The department furnishes and places all taps and connections to city mains, the taps including wet connection sleeves and valves up to 20 inches by 24 inches being manufactured under departmental designs and specifications. Application for the tap is presented by a licensed plumber, and the size of tap granted is based upon the number of square feet of floor area in the building, the general standard being shown in the following schedule:

The area of one $\frac{5}{8}$-inch tap shall be credited for the first 7500 square feet of floor area, one $\frac{3}{4}$-inch for the first 15,000 square feet and above 15,000 square feet one $\frac{5}{8}$-inch tap for every 10,000 square feet of floor space thus computed (or an equivalent combination of larger taps) viz:

Up to 7,500 square feet	1-$\frac{5}{8}$-inch tap
7,500 to 15,000 square feet	1-$\frac{3}{4}$-inch tap
15,000 to 20,000 square feet	2-$\frac{5}{8}$-inch taps
20,000 to 30,000 square feet	3-$\frac{5}{8}$-inch taps (or 2-$\frac{3}{4}$-inch taps)
30,000 to 40,000 square feet	4-$\frac{5}{8}$-inch taps (or 3-$\frac{3}{4}$-inch taps)
40,000 to 50,000 square feet, etc	5-$\frac{5}{8}$-inch taps (or 2-1-inch taps)

Where the occupancy of a building will require an unusual volume of water, the size of tap granted is in accordance with the probable demand. This system of floor area as a basis for determining the size of tap has been in use for the past three years and has given general satisfaction. Prior to its adoption, there was no standard by which to judge the size of tap to be allowed and there was, naturally, resultant dissatisfaction and charges of favoritism. After the size of tap has been determined, the excavation is made by the plumber, who notifies the department that the opening will be ready for the tapper on a given date and hour. The tapper is furnished with a

card authorizing him to insert a given sized tap and he returns this card with endorsement showing the size of tap inserted and the location of same. This information is then transferred to a tap card for filing, illustrated on Plate No. 8.

The department charges the property owner a fixed price for each size of tap, the present schedule being as follows:

CHARGES FOR WET CONNECTIONS

Connection	*Pipe Inches*	*Rate*
2 inch	6	$23.95
	8	25.45
	12	34.70
	16	40.45
	20	48.20
4 inch	6	27.50
	8	30.20
	12	38.15
	16	43.90
	20	51.65
6 inch	8	36.55
	12	45.95
	16	54.70
	20	59.95
8 inch	12	55.00
	16	66.75
	20	71.25

CHARGES FOR TAPS

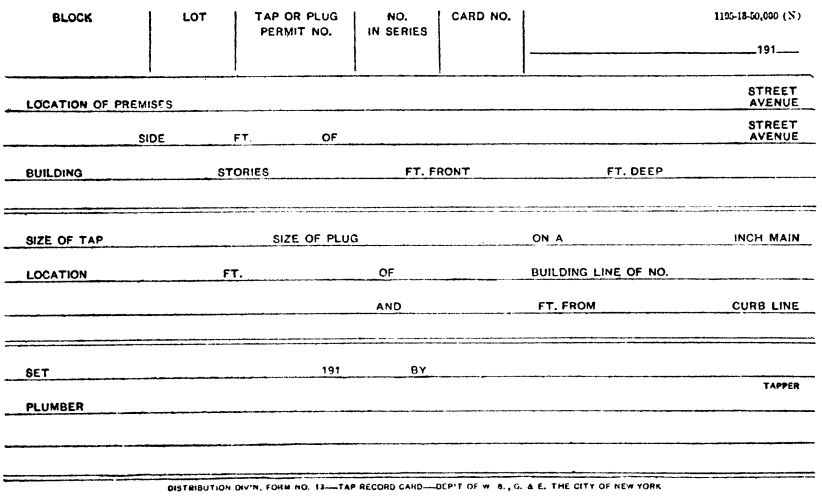
Size	*Rate*
⅝-inch	$4.50
¾-inch	5.00
1-inch	6.00
2-inch	15.00

All house services up to and including two inches in diameter are required to be of lead from the tap to the property line. The tap and service is inspected by an employee of the Bureau of Water Register, and the charge for water dates from the approval of the service and the turning on of the corporation cock. This cock is buried in the street and a curb cock set at the curb line.

Shutting Off Leaky Service

When notice of a leak is received effort is made by examination of the surface and use of the aquaphone to determine whether the

leak is on a service or the city main. As the services are owned by the property holder, he is notified to make repairs, if the leak is probably on his service. If its location is uncertain, the department gang digs up the main and continues excavation until the leak is found. If the leak is finally found on the city main it is repaired by the city force. If the leak is on a private service, the corporation cock is shut off and the repair work is turned over to the plumber representing the property owner. The department formerly billed the property owner for all excavations necessary to locate the leak. This procedure resulted at times in a severe


BLOCK | LOT | TAP OR PLUG PERMIT NO. | NO. IN SERIES | CARD NO. | 1195-18-50,000 (S)

191

LOCATION OF PREMISES — STREET AVENUE

SIDE FT. OF — STREET AVENUE

BUILDING STORIES FT. FRONT FT. DEEP

SIZE OF TAP SIZE OF PLUG ON A INCH MAIN

LOCATION FT. OF BUILDING LINE OF NO.

AND FT. FROM CURB LINE

SET 191 BY

TAPPER

PLUMBER

DISTRIBUTION DIV'N. FORM NO. 13—TAP RECORD CARD—DEP'T OF W. S., G. & E. THE CITY OF NEW YORK

PLATE 8. RECORD TAP CARD

burden being placed upon the property owner, as where the subsurface conditions were favorable, such as in a rock filled street, the leaking water might run for several hundred feet before it appeared at the surface. Numerous openings had to be made before the leak was discovered, and bills of several hundred dollars were not uncommon. Now the department charges only for the excavation which finally locates the leak, believing that the city should carry the extra charge as an insurance against any one property owner being heavily penalized, due to no fault of his own.

While curb cocks are installed, they are not of material use in locating leaks on services, as such leaks are usually between the main and the curb cock.

To insure payment for work done by the department, the plumber is called on to assume responsibility for the pavement disturbed and excavation made before the water is again turned on.

Pressure in Premises

New York City has, in general, a low pressure, the average in Manhattan and The Bronx being about 30 pounds, Brooklyn and Queens have approximately 35 to 40 pounds, while Richmond varies from over 100 pounds down to 20 pounds or less.

Many Manhattan and Bronx premises have tanks or house pumps, or both, but even with such auxiliaries in use the complaints of lack of pressure are quite frequent. Such complaints are turned over to an inspector who takes the pressure at the nearest hydrant, in the basement and on each floor, with and without a faucet flowing, and notes the size of the supply pipe from the main and the size of each riser and number of floors supplied by each. After the data obtained has been studied, the owner is notified of the conditions found, the probable cause of lack of pressure, and what action is necessary to remedy the conditions complained of.

Hydrant Repairs During Freezing Weather

The fire department force make continual inspections of hydrants during the winter months and report to the repair company headquarters hydrants that are frozen or in danger of freezing. These are then examined by the department force and the waste drip cleared and hydrant drained or else pumped out. Salt is placed in hydrants which leak slightly and do not drain properly. Experiments with the use of glycerine, alcohol, and carbide of lime as substitutes for salt are being made, but there is not sufficient data available on which to draw conclusions. Hydrants that are frozen are thawed out by the fire department, using the standard steamer, and by the water department, using a special portable boiler.

Operation of Valves

With about 60,000 valves in the system, it is difficult to operate the valves frequently enough to keep all valves in good condition. The department plans to operate and oil every valve once a year,

but so far has been able to keep up to this schedule for the large valves only, i.e., larger than 20 inches in diameter. With New York City water if valves are operated once each year they are kept in good general condition ready for operation at any time. It has recently been the practice to place metal pans over the gears to protect them from dirt. The boundaries of services are usually formed by closing valves, thus creating dead ends. Sediment collects in such dead ends and can only be removed by partially opening the valve and blowing off the sediment laden water through the adjoining hydrants. Special gangs are operating continuously on this work, the mains being blown out at intervals of from two weeks to several months, the time depending upon the rapidity with which sediment forms in objectionable quantities.

Response to Fire Alarms

The water department is responsible for the adequacy of the supply for fire extinguishment. Fire alarm gongs are located in all repair company headquarters, and a repair company gang responds to all two alarm fires in the low or domestic pressure districts. To all alarms in the high pressure fire service district, a special repair gang responds. On arriving at the fire the driver gets in touch with his headquarters so the gang can be located, and the men are held to act in case of emergency, such as lack of water, which might be relieved by opening adjacent district boundary gates. The foreman notes the location and number of engines, water pressure, etc.

Assignment of Assistant Engineer for Night and Holiday Duty

On the theory that men familiar with the water supply system and competent to act in emergencies should always be available, assignments are made so that two engineers, one for Manhattan and The Bronx, and one for Brooklyn, are always in reach of the telephone from the time the office closes until it is again opened. The city furnishes telephones in the homes of these men, but they do not receive any added compensation due to such additional duty. These men are called out for three or four alarm fires, as well as in emergencies resulting from any cause. They take charge until they are relieved by a higher official.

Controlling Pressures in Mains

Recording pressure gauges are located in the various repair headquarters and pumping stations, and also in some sixty fire company engine houses scattered throughout the city. These gauge charts show if there has been any unusual pressure changes and studies can then be made to determine cause and remedy.

The pressure in the Brooklyn low pressure system and the First Ward, Queens, is controlled by the operation, day and night, of headgates at the reservoir. If the pressure is normally in the day time between 35 and 40 pounds, it will rise above 45 pounds at night when such increase in pressure is useless. The pressure is, therefore, kept high from 5 a.m. to 11 a.m. From then until midnight it is kept about 5 pounds lower than during the morning, and at midnight it is further lowered about 6 pounds and kept at the low point until five in the morning, when the gates are again opened. With four 48-inch and two 36-inch mains feeding the service from the reservoir through six 36-inch valves, it is found necessary to have all valves opened from 12 inches to 18 inches in the morning, there being no effect if the valves are opened more than 18 inches. During the early morning hours three of these valves will be shut, two opened about 4 inches, and one, on a main that feeds a service pumping station, about 12 inches. Pressures are telephoned to the reservoir every hour and more frequently, if required, and men are on hand to immediately open valves if required. If a three alarm fire is recorded the valves are immediately opened, about ten minutes being required to give full pressure.

This system has been in use for nearly ten years, and no trouble has been experienced. The control of the pressures reduces the consumption by over five million gallons daily, or about five per cent of the total supply to this service. When all the water is pumped and difficult to obtain, this saving in water is material and is worth financially between $100 and $200 per day.

Measurements of Flow in Mains and from Hydrants

In studying trunk main capacity, the distribution of the flow is an important factor in determining whether existing mains are being utilized to full capacity, and also whether new mains are needed. Pitometer surveys are being made from time to time for this pur-

pose, three parties being continuously employed on this and similar work, the department owning 15 instruments. Measurements of flow are also undertaken to determine leaks outside of premises and as a result of such work during the past four years, i.e., from 1910 to date, leaks in mains and services have been located and stopped, amounting to 33 m.g.d. An interesting leak that was found by such measurements is shown on Plate No. 9. This was considered by the local inhabitants to be a spring which yielded water of a superior quality to the city water, and they were much surprised when the leak was discovered and the spring ceased to flow. The volume of water lost through fixture leakage is determined by the pitometer measurements, flows being recorded into districts before and after water waste prevention inspections have been made. The adequacy of the distribution system to deliver an ample supply for fire extinguishment is determined by testing the flow from hydrants, usually using a group of six and noting the drop in pressure and the discharge from each hydrant. Pitot nozzle gauges are used for this purpose, the force employed being the regular pitometer survey force.

Checking Waste in Building

Waste of water from fixtures within buildings has always been one of the problems that water works engineers and superintendents have had to contend with, and no satisfactory answer except metering has been found. Where metering is not permitted some other means must be adopted if the consumption per capita is to be kept within what is generally considered reasonable limits.

The consumption in Manhattan and The Bronx in 1910 was 331 m.g.d. with an estimated population of 2,762,500, making the per capita consumption 120 gallons daily. For the twelve months from July 1, 1911, to July 1, 1912, the consumption was 291 m.g.d., which, with an estimated population of 2,838,500 in 1911 would give a per capita consumption of 103 gallons daily. For Brooklyn, with a consumption of 155 m.g.d. and a population of 1,685,000 there was a per capita consumption of 92 for 1911, which was 5 gallons less than that recorded for the preceding year. In 1913 the consumption was 140 m.g.d. with a population of 1,791,100, giving a resultant per capita consumption of 78 gallons daily.

The reduction in consumption has been accomplished by water waste prevention inspection and by the stoppage of leaks in the

LEAK AMOUNTING TO 1,400,000 GALLONS PER DAY, WHICH APPEARED AS A "SPRING" IN A SWAMP 100 FEET FROM THE LEAK. LEAK DISCOVERED BY PITOMETER MEASUREMENT

LEAK FROM MAIN RISING DIRECTLY OVER BREAK WHEN OPENING WAS CUT THROUGH SWAMP SOD. SHUTTING OFF OF THIS LEAK IN THE 8-INCH MAIN INCREASED THE PRESSURE ON A PARALLEL 20-INCH MAIN FROM 36 POUNDS TO 51 POUNDS

distribution mains and service pipes outside of buildings. It has already been stated that the total amount of leakage outside of buildings discovered and stopped during the past five years has amounted to about 33 m.g.d. The main reduction in consumption has therefore resulted from the water waste prevention work. The general procedure followed in this work is as follows:

Printed notices are delivered on the premises, calling attention to the necessity of preventing waste of water. This is followed by a house to house canvass, all fixtures being examined by an inspector. If any leaks are found the inspector leaves a notice of such leaks, the notice calling for repairs to be made within three days. A duplicate of this notice is mailed to the premises from the department office. A re-inspection is made after three or more days and if all leaks have not been repaired a fine of $2 per premise is imposed. This fine is repeated if later inspection shows that the necessary repairs have not been attended to.

Before the inspectors go into any district, pitometer measurements are taken on mains which can feed said district, valves being temporarily closed to fix the boundaries. After the inspection is completed and the leaks stopped, the flow into the district is again measured and the leakage stopped computed.

Two extensive inspections have been made during the past four years, one in 1911 in Manhattan where the maximum leakage stopped in a five months' campaign was estimated to be 71 m.g.d., of which 21 m.g.d. is attributed to the house to house inspection and the other in 1912–1913 in Brooklyn, where it was estimated 30 m.g.d. was saved as a maximum. The inspectors employed in the first investigation reached a maximum of 114, while the total number of inspector days expended in inspecting and re-inspecting buildings and locating 197,000 leaks was 11,600 days. Each inspector received at the rate of $1100 per annum and pitometer gaugings of flow into districts inspected cost about 35 percent of the inspection cost. The fines imposed just offset, however, the cost of these gaugings. The net cost of saving the water, assuming that all the leakage stopped would eventually reappear in two years time (experience shows that the actual time is longer) was about $7.70 per m.g.

In Brooklyn in ten months, with nearly forty inspectors and 8800 inspector days, the net cost of saving the water was estimated at $3 per m.g. using the same basis of computation as for Manhattan.

The maximum daily reduction in consumption per inspector employed is estimated at 900,000 gallons. The yearly reduction in annual expenditures resulting directly from this checking of leakage is estimated at $400,000, while the total cost was about $36,000, and the net cost, allowing for fines imposed, less than $30,000.

The limited data available indicates that after six months' work the inspector is stopping leakage at about the same rate as the leakage previously stopped is reappearing. The work of inspection is under the Bureau of Water Register, but the outlining of the water waste prevention campaigns has been done by the Bureau of Water Supply.

RECORD MAPS OF DISTRIBUTION SYSTEM

For general use as wall maps and for the use of foremen and others in the field, tracings to a scale of 400 feet to the inch have been prepared, showing by symbol size of mains, connections, valves, hydrants, blowoffs, etc. Street lines are omitted except in outlying sections, as the mains indicate the streets and the additional lines are confusing. These maps are kept up to date and prints in the repair companies' headquarters are corrected each month as far as practicable. The boundaries of services are shown by colors.

Atlases to scales of 100 feet to an inch and 160 feet to an inch have been tried to record actual locations of mains, valves, hydrants and appurtenances, with depth of cover, when laid, etc. These have not been a success and it is considered that drawings to a scale of 40 feet to an inch will be more suitable with a scale of 20 feet to an inch being used where there are very complicated intersections. On the large sized scales can be shown location of taps as well as other details.

For the high pressure fire system each hydrant is numbered and maps to a scale of 300 feet to an inch are used for general maps, with the same sized scales for the detailed maps.

All the work of collecting, transporting, pumping and distributing the water supply for Greater New York is under Mr. Merritt H. Smith, Chief Engineer of the Bureau of Water Supply. The writer as Deputy Chief Engineer has come in close touch with the maintenance and operating problems and has found these studies most interesting. A more general statement of practice by the various water departments of our cities would be helpful in developing sound procedure in this branch of water supply.

DISCUSSION

MR. D. W. FRENCH: Will Mr. Brush kindly state whether should a break occur in the pipe system during a period of fire, resulting in a general reduction of pressure in the high pressure system, the department have any means of controlling the gates to shut off the damaged part of the pipe system, electrically from some central station, or if the gates would have to be operated by hand.

MR. WILLIAM W. BRUSH: In the domestic system, New York City does not have any hydraulically or electrically operated valves which may be opened from a distant control point to permit delivery of the supply from a higher level district into a lower level district. The boundaries of the different services are created by closing valves, and in case of an unusual demand, created by a break or other cause, one or more of these boundary valves are opened by the repair gang. In general, the distribution system is so proportioned that there is little need of delivering water from a higher to a lower level, although ten years or more ago this was necessary rather frequently in cases of large fires located near boundaries of services.

In the High Pressure Fire Service system there are electrically operated valves controlled from the pumping stations and used to separate the system into two parts, said valves being closed in case of a break. In the newer parts of the system alternate streets are on one system with intermediate streets on the other system, thus materially reducing the danger of the whole system becoming inoperative throughout any district, due to break in the mains or appurtenances.